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The *Journal of Thought* is a quarterly publication devoted to the reflective examination of educational issues and problems from the perspective of diverse disciplines. The journal strives to encourage scholars of diverse disciplines, nationalities, and cultures and it treats the most comprehensive issues and problems confronting education throughout the world. The editors solicit essays, reports of research studies, analyses, and critiques that synthesize diverse points of view and encourage interdisciplinary dialogue.

Editorial correspondence should be addressed to Robert M. Lang, Editor, *Journal of Thought*, Northern Illinois University, Leadership & Educational Policy Studies, DeKalb, Illinois 60115.

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EDITOR'S COMMENTS

Educational Technology, in its relatively brief history, has changed many aspects of the teaching/learning process. As technologies have advanced education and other areas of endeavor, they have created new concerns and problems as well. This issue of the *Journal of Thought* presents some of these concerns, bringing to readers an historical, philosophic, and social critique of some of the current issues in the field.

Ann DeVaney's essay provides a new and useful perspective. In arguing against the limitations of the narrow focus of positivism and deduction, Ann presents rules of evidence from the fields of law and science. By comparing our definition of rules and known from law or science with those of educational psychology/research, Ann points out the limits of our research.

Steve Kerr examines what technology in education is really about, helping us to look beyond devices and processes. Providing us with a short history of technological innovations such as printing, the telephone, and television, Steve points out that most innovations are not used now as they were first intentioned. Kerr again reminds us that the social implication of technology education has been ignored, and that the impact has been substantial and pervasive in classroom use, organization, and the role of education in society.

Eunsoon Kwak and Gary Anglin attack the notion that instructional design and technology are "value neutral," and trace our ways of knowing to their "scientific" research roots and definitions.

Using arguments from Cherryholmes and Hoban, the

authors argue that the social level of the systems approach is rarely if ever considered in instructional design.

John Belland and Phillip Smith call for the reintegration of virtue into educational technology concerns. By tracing the history of virtue for Machiavelli, Hobbes, and Nietzsche's work, the authors stress the changes in the term "Virtue." They apply it in education today, and suggest that educators, especially educational technologists, should devote themselves to the encouragement of the intellectual and critical skills required in the world of today and tomorrow.

Denis Hlynka and Chris Chinlen's essay first explains the dichotomous traditional views of Educational Technology positivist vs. hermeneutic. It then discusses the more useful framework provided by Habermas, a trichotomy of interests, providing example research questions. Finally, the authors suggest a post modern construct that allows for multiple paradigms, criticism, aesthetics, and interrelations, citing Cherryholmes and Foucault.

Suzanne Damarin argues from a feministic perspective. She presents some versions of present technology use and visions of future use which dehumanize and still "genderize" education and society. From the technological perspective, she questions whether the increased development of computer use in education is a positive innovation. Damarin asks us to examine, analyze, and question society's sense that computers are becoming more "user friendly"; beyond that, she questions whether the developments in CAI and AI are not anti-education as well as anti-feminist.

Bob Muffoletto examines the role of media education within teacher education. He posits that media education is not the teaching of particular production skills and

computer literacy. It is, however, the critical analysis of all the "texts" of education, mediated or not. Muffoletto believes that the mediation of education may indeed be dis-empowering the teacher and the school, and placing the control in the hands of publishers and other "knowledge" producers. In this way, he argues, control of knowledge of learning, and of the teaching profession could be (is) taken from teachers and given to a powerful elite.

William Taylor and Eva Konstantellou agree with Kerr, Kwak and Anglin that technology is not value neutral. Their argument centers around the question of responsibility: Who is responsible for learning and instruction? They trace this question historically, especially comparing instructional design learning gains to the Carnegie unit. The question of responsibility, they feel, has an inevitable answer given the constraints of our field.

Randy Nichols takes a very dark view of our future, forecasting in near catastrophic terms the events that will/may shape education and educational technology. While providing a compellingly bleak vision, Randy does suggest some alternatives for avoiding technological calamities.

Rhonda Robinson
Northern Illinois University

RULES OF EVIDENCE

Ann DeVaney
University of Wisconsin

There is no rule for applying a rule.
Immanuel Kant

Truth, conretely considered, is an attribute of our beliefs.
William James

That which constitutes evidence for educational researchers working in the cognitive paradigm is amply clear. There, products of individual brain functions are routinely quantified and submitted to statistical measurement, but application of statistical measures as rules of evidence is more widespread. In schools of education across the country, graduate students are not only required to study statistics, but are usually taught that numbers are the only irrefutable evidence. Even though qualitative methods are being adopted by a critical mass of educational researchers and the results of their studies published by some editors, few non-statistical methods courses exist for graduate students. Many graduate programs in education have none. Perhaps there is a blurring of the boundaries between psychological and non psychological theories of learning. It is a fact that learning is not only a psychological construct, but a social one, therefore, many educational researchers prefer to work with theories which posit the social construction of knowledge. There is not, however, a general recognition of the fact that rules of evidence necessarily differ from

paradigm to paradigm. This problem exists, because psychological theories of learning form the dominant paradigm in education, but it also has historical roots.

Any profession defines itself, in part, by boundaries and entry requirements as does the area of educational research. After World War II, educational researchers gained academic status by embracing the theory and laboratory practices of psychologists. Educational psychology became synonymous with educational research. A minor example of the manner in which this occurred can be described. When educational psychology professors, including Skinner, were inducted in the Army and Navy during World War II, they were directed to design training materials (Saettler, 1968). Additionally, public school principals and district superintendents were drafted to teach training sessions with these materials. This was an unusual conjuncture. It was a specific moment in time in which educational theory which, heretofore, had been only semi-rigorous, gained rigor and, consequently, respect with the application of operant conditioning. This neo behavioral theory dovetailed perfectly with military pedagogy. A better fit could not have been planned. Military pedagogy was hierarchical and expert-based and Skinner's theory attempted to isolate and control learning tasks. It was no accident, then, that neo behaviorists, i.e. Gagne and Bloom, who engaged military pedagogy when using training materials to teach recruits, developed hierarchies of behavioral tasks in the cognitive domain.

Specific Problem

If one practices educational research in a social paradigm, what constitutes rules of evidence? How can rules of evidence for social paradigms be established and promulgated within the profession? These issues become

crucial when the question, "How do students create meaning?" is posed. While theoretically worlds apart, this question is a variation of the cognitive query, "How do students learn?" If a social theorist in the field of education collects data from students, how does she convince other educational researchers that, in her paradigm, numbers may not constitute evidence. In other words, if one works with a traditional unit of analysis (the student) in the field of education, why are new rules of evidence needed and what are these rules?

In this essay I will address these questions. I will explore whether the establishment of rules of evidence is possible or even necessary. An alternate framing of the question about rules of evidence is, "How do researchers and practitioners in a specific field know what they know?" I will describe the concept of evidence in law and science. Specifically, I will show that the adoption of statistics as evidence in educational research was historically a clear misreading of the "scientific method."

Definitions

While the concept of evidence tends to remain domain specific, it shares some similar characteristics from discipline to discipline. To capture this one can consider the definition. "Evidence" is an outward sign, an indication; something that furnishes or tends to furnish proof. It is testimony. Something is evident if it is capable of being perceived, especially by sight; if it is discernable; if it is clear to the understanding (Webster, 1976). The generic concept of evidence includes no mention of measurement or numbers. In fact, its Latin base is *e* (from) and *videre* (to see). The equating of numbers with evidence provides a quite narrow construction of the concept. Historically, the

word had been central to the language of many fields from law to science.

More specifically, evidence can be something legally submitted to a tribunal to ascertain the truth of any alleged matter of fact under investigation before it (Webster, 1976). This is obviously a legal application of the term and when applied the concept of evidence becomes domain or paradigm specific. Within fields evidence becomes a concept informed by theory and concomitant underlying assumptions, as well as practice.

Since the concept of "rules" is also central to this discussion, it is important to consider additional definitions. Webster (1976) defines a rule as a proscribed guide for conduct or action; an accepted procedure custom or habit; a standard by which something is suggested, judged or valued. It can be the principle regulating the practice of an art or science. It is also the exercise of authority or control. The broad concept of rules suggests games and winning and losing. As one speaks about rules, the notion of boundaries emerges. For Quine (1953), rules are boundary conditions and the notion of a rule suggests the establishment of a profession and professional criteria, rather than any specific theory. In fact, the word *rules* was originally applied to a limited area near a prison for the residence of certain categories of prisoners, i.e., debtors (Webster, 1976). Certainly, the establishment of formal rules prohibits as well as allows entry into a profession.

More specifically, a rule is a legal precept applied to a set of facts. Rawls (1971) notes that rules of institutions are constitutive conventions which specify certain activity and define certain action. The legal profession, it appears has

noted the relationship between the establishment of rules and the action of humans, therefore, this field may provide more insights.

Law

The field of law is an applied social science and although it is apparently dissimilar to the social science of education, particularly educational research, some instructive junctures exist. The practical nature of the legal profession makes its participants particularly sensitive to the relationship between theory and practice. In this arena, principles of order and justice accepted by a given society are to be applied when reaching legal decisions (Rawls, 1971). And these are decisions for action. More specifically, legal practitioners attend to the relationship between reasoning and the social context in which it takes place.

Thus, the legal experience not only provides a wealth of data for investigation by social scientists but also has much to teach them concerning the nature of social science. Indeed legal reasoning challenges the belief that any social science can properly avoid the question of its applicability to society. It challenges, therefore, the theory of a value free social science based on the methods of the physical sciences or of mathematics. Such a challenge is inherent in the emphasis which law places on the connection between what is said and the role of the speaker, as well as the assumption implicit in law that a judgement affecting persons is not merely an observation or measurement of external facts, but also a response to the language addressed to the person making the judgment, and that a proper judgment in itself is addressed to the participants in the proceedings in which it is made (Levi, 1949, p.204).

Educational research is generated by theoretical con-

structs or everyday educational problems for the ultimate purpose of improving practice, yet this area has not always attended to the links between theory and practice.

Evidence or How They Know What They Know: Old Model

Legal reasoning is based on rules of logic, and specific forms of rhetoric and discourse. The twentieth-century applications of these rules of logic is less mechanistic than the legal model applied in the eighteenth and nineteenth centuries. During those earlier centuries an attempt was made to make legal reasoning conform to strict syllogistic logic; rules of law were considered major premises and facts of individual cases were minor premises. The assumption underlying this practice was that if an entire body of law could be summarized in a set of rules, the only task remaining would be the classification of specific facts under one rule or another (Levi, 1949). (These goals sound strangely similar to the goals of some psychological learning theories.) Legal practitioners, however, recognized the inhumane nature of this mechanistic model, sometimes called the "jurisprudence of concepts" (Fuller, 1964), and sought to make it more responsive to social and personal interests. They recognized the fact that their model was inattentive to culture as are psychological theories of learning.

One legal innovator was Oliver Wendell Holmes who noted in 1881 that the life of the law was not truly formal logic, but that logic was a veil for judges who simply employed their own views of public policy (Fuller, 1964). Along with others, he was recognizing the fact that no matter how framed, there is always an intimate connection between the logic of law and the dominant beliefs of society.

New Model

What became unworkable in the mechanistic legal model was the application of strict syllogictic logic. Legal rules when considered as major premises are always subject to qualification in light of specific circumstances. Also, events occur for which there is no existing rule. No one can detail the limits of freedom of speech, for example, since the social context in which the words are spoken are continually changing (Fuller, 1964). Even the "facts" of particular cases which were considered minor premises in the mechanistic model, require evaluation and interpretation. And the conclusion, which is the application of a rule to a specific case, is never mathematically inevitable, but depends upon the exercise of judgment (Levi, 1949). In other words, there are no rules that can predict with certainty how a particular judge ought to resolve a particular case. Perhaps legal practitioners came face to face daily with the application of their theory, while educational researchers could maintain a distance between themselves and learners. Practical classroom issues have, however, spurred a critical mass of educational researchers to consider theories sensitive to culture.

Rules and Culture

Although legal practice in the United States is not always an articulation of its theoretical construct, it is a field which remains attentive to customs and culture and it might help us to attend to the manner in which it does this. Law is not only a body of rules, but an activity, an enterprise. It is also an appeal to custom and to a sense of justice. Custom is considered a combination of what is commonly done and what is commonly believed ought to

be done. There are four sources of law; legislation, precedent, custom and equity. Legislation is directed to what should be done in the future, precedent to what has been done in the past, custom to social patterns and norms of behavior and equity to an inner sense of justice (Berman, 1958).

It appears to me that assumptions of order and justice underpin the construction of and the practice of law in the United States. That is the program. Evidence is brought to bear on the enforcement of these assumptions and that is the enterprise of law, for law, as has been noted, is not only a body of rules, but an enterprise, an activity. Evidence is collected, so that the enterprise can be carried out and this activity is most like that of the social sciences, particularly education. It would be futile for researchers in education to collect data without considering the ends to which their findings will be used.

The dominant form of legal logic is that of analogy, in the broad sense of the comparison and contrast of similar and dissimilar examples" (Levi, 1949). When educational researchers collect interview or anecdotal information, these data have the possibility of being organized by analogy or opposing claims. Analogical thinking is inductive, not deductive. In law, facts of the case are first analyzed and then legal principles are inferred from them.

Similar Goals

Social scientists do not propose to collect data without considering the larger enterprise and ascertaining the use which will be made of their data, but unfortunately, it often happens that way. As in law, educational data must always relate to the larger enterprise. Legal practitioners are used to accounting for custom and culture. They integrate this

concern with the existing bodies of knowledge. Justice and impartiality informs their action, and analogy is an integral part of their discourse.

Science

As educational researchers we have generally borrowed our methods of data collection and analysis from behavioral and cognitive psychology which, in turn, has been informed by what appears to be scientific rigor and the scientific method. Let us grant, for the moment, that the field of science is a fertile field from which educational researchers may gather methods of data collection and analysis, but the breadth of those techniques has not been described. Much educational research has focused on narrow rows and columns of this fertile field. The excessive use of ANOVA is a small metaphor for this borrowing. Originally, ANOVA was developed to help predict the expectant crop when seeds were planted in rows and columns. But scientists who study animals have much more to say to us than that which comes through the narrow channels of behavioral and cognitive psychologies. (Instead of dwelling on this narrow appropriation as has been done so often in the past, let us look at what science can offer, if the area is construed more broadly).

Some guidelines in this quest are offered by James (1972) and Quine (1953).

> The totality of our so-called knowledge or beliefs, from the most casual matters of geography and history to the profoundest laws of atomic physics or even of pure mathematics and logic, is a man-made fabric which impinges on experience only along the edges (Quine, 1953, p.42).

The perception that all scientists are logical positivists, mechanists who would refute Quine's description of knowledge, is inaccurate. If, in fact, it were so, research in basic and applied science would slow to a snail's pace. Many scientists agree that their:

> . . . total field is so undetermined by its boundary conditions, experience, that there is much latitude of choice as to what statements to reevaluate in the light of any single contrary experience (Quine, 1953, p.43).

Quine suggests that "boundary conditions" or rules, as I refer to them in this essay, are simply the broad realm of experience. One would think that "experience" because of its generic nature would not be the concept to provide specific rules, but Quine counters that contrary experience, which refutes rules drawn from ordinary experience, proves that notion false. James would agree with him. Anyone will renovate his science who will steadily look after irregular phenomena (James, 1972, p.255). One could call James' "irregular phenomena" Quine's "contrary experience." But James details the concept until it appears unlike the popular notion of science.

> [Science] is perennially fed by facts of experience, whatever the ulterior interpretation of those facts may prove to be... These experiences have three characters in common: they are capricious, discontinuous and not easily controlled;... (James, 1972, p. 256).

Instead of evincing the variables of isolation and control which are most often associated with scientific inquiry, James is detailing a process which appears to describe human behavior and, consequently, some of the issues which

puzzle educational researchers. He moves us further along in this inquiry about rules of evidence when he mentions the characteristics of the type of evidence educational researchers collect. In attempting to describe and measure how students learn, educational researchers are attempting to describe and measure capricious, discontinuous and not easily controlled experiences (use Taylor).

Do these philosophical observations, however, reflect the daily practice of science? An interview with a practicing cell biologist (Sonneborn, 1990) indicates that Quine and James provide us with insightful observations. The popular notion of the scientific method, it was noted, is somewhat sterile. What actually occurs on a daily basis in laboratories has more to do with irregular phenomenon and contrary experiences. It is the mutant or the anomaly that is sought and this search is often independent of notions of quantification, let alone statistics. Sometimes qualitative information, i.e., a cell that does or does not have a specific protein, is all that is needed. Or, in chemical manipulations, sometimes simple quantification is necessary. The apprehension that quantification is always necessary in science is false, and the idea that statistics is the most frequent measurement applied is likewise false. Since a statistic measures the behavior of large populations, it is used only when distributions or trends are needed. One does not need statistics to describe irregular phenomenon, nor to do simple quantification.

The basic methods applied in biology laboratories are simple manipulations or perturbations of a system. The experimenter has limited choices. She can only remove a part, remove a part and put it by itself or recombine parts. The basic question that developmental biologists ask is, "How do parts become different in time, space and relative

amount?" Often, calculus is most suited to measuring these variables.

From the results of this interview and my readings in the philosophy of science, I conclude that the conception of science and scientific rigor which dominates the area of educational research, and which was borrowed from the field of psychology, is overly constrained by the adoption of narrow methods and limited use of the mathematics of probability.

Conclusion

The history of educational research and current subscription to the dominant cognitive paradigm do not provide the sole impetus for a narrow construction of "evidence." In an age in which many events and much knowledge is undetermined or relative (Chaos Theory, Deconstruction, Post Modernism, etc.), there is solace in numbers. Statistical results often provide the false comfort of "knowing." Historically, statistical measures were used to describe variables such as population, area, wealth. The use of statistics and interpretation of numerical results assumes the ability to assign rational categories to the variables of interest. A category of wealth, therefore, would yield such categories since it has measurable comparable units within its scope, such as net income, savings, investments, etc. Rational categories and comparable units are not always inherent in the variables and issues of interest to educational researchers. But researchers who are looking for specific answers to improve classroom practice in flagging educational institutions often couch their recommendations in comfortable numbers. It appears that statistics somehow becomes related to anxiety and the wish for answers.

In addressing this global angst, Edward Said (1983) has recommended that researchers work with non coer-

cive knowledge which is produced in the interest of human freedom. His suggestion sounds similar to the legal program described above and the mechanisms by which one could achieve this work is similar to the legal enterprise described above. Said encourages us to remain disbelieving, cosmopolitan and above all oppositional as we work. This essay may raise more questions than it answers, but hopefully, it will provide an impetus for educational researchers to expand their current understanding of the notion of "evidence." Evidence, it appears, is a concept narrowly conceived in educational research, yet in law, science and some social sciences evidence has a broad construct.

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EDUCATIONAL TECHNOLOGY IS NOT ABOUT TECHNOLOGY

Stephen T. Kerr
University of Washington

The field of educational technology has evolved a dual definition of what the field is about: both "devices" and "processes" are featured in that definition. Devices came first, and they were mostly what the field was about until relatively recently. "Audio visual," "visual education," "teaching machines," "computer-assisted instruction"–the names the field has been known by, and the images those names still conjure up in the minds of most educators, express those origins and remind us of the links the field has to devices. Over the past two decades, a different vision of the field has emerged, one that focuses on process over machine. In this interpretation, it is the strategies of instructional design and development that constitute the essence of the field, and that offer the promise that more truly effective and rational methods of instruction may eventually find their way into educational institutions. (See *The definition*, 1977, for a professional association's view of the distinction between the approach based on devices and that based on processes, and Heinich, 1971, for a key document that led to the reconceptualization of the field twenty years ago).

My claim here is that the vision of educational technology that has evolved over the past twenty years is no longer large enough to encompass the changes that it is in fact capable of bringing about in schools and other educa-

tional institutions. We need to expand by another order of magnitude our view of what technology in education is about. I want to suggest here that educational technology is principally about neither devices nor processes, but rather about reorganization of the fundamental social parameters in which education is embedded.

Justifying this claim requires two sorts of evidence: first from history, where we find many examples of earlier technological changes which brought social consequences that went far beyond simply solving the problem the technology ostensibly was meant to solve; and secondly from current practice, where we may see cases in which educational technology has affected (or appears to be affecting) what goes on in schools and colleges in profound ways. To fairly indicate that what educational technology may be about goes beyond both devices and processes, we should be able to demonstrate that both technological devices and technological processes can have important social consequences that exceed the expectations of those who originally proposed and developed the technologies involved.

Background: Technology as Social Catalyst

Printing and the advent of modernity. We often think of printing as an invention that was intended to lower the cost, increase the accuracy, and improve the efficiency of producing individual copies of written materials. This indeed was true, but printing had other, secondary consequences that were primarily social in nature, and that were not directly intended by Gutenberg, Aldus, and other early printers. Governments began to demand more types of information from local administrators, and to circulate and use that information in pursuit of national goals that would have been inconceivable without the large volume of available

data that printing made available. Literacy became possible for larger numbers of people as texts of all kinds declined in price; this same development changed education as lecturers' absolute control over knowledge weakened with the spread of information. The reliance individuals placed on developed memory declined, and the whole class of clerics and scholarly monks who had served as the producers and interpreters of the written word began to lose their power.

Printing, then, was a technological innovation that had a significant social impact. The changes it brought came slowly, and they were not in most part anticipated (or, in many cases, desired), but they were powerful in helping modernity to displace feudalism and in shaping the contemporary social and political structure, as well as the mental superstructure we all use today. (See Boorstin, 1983, Eisenstein, 1979, and Luke, 1989, on the development and consequences of printing).

The telephone and conceptions of work. The telephone, a more recent technological innovation, seems more straightforward, perhaps because it is so familiar. Certainly telephones were developed to allow easier, more rapid communication between individuals. While this was true, it is easy to forget that the system of telephone service we have now was not in any way visualized by Alexander Graham Bell; what he saw was a need for individuals to talk with defined other individuals repetitively–a manager would have a telephone line from his home to his plant, and if he wanted also to be able to call a local supplier, he would need a second line. The notion of networks developed later. Many early enthusiasts saw the telephone taking on functions (dissemination of news, music, public lectures) that in fact only developed with the advent of radio.

But what the telephone did bring was a rapid recon-

ceptualization of what the workplace could and should be. Before the telephone, workers (especially the "information workers" of their day–newspapers, financial firms, etc.) tended to be clustered more tightly, since communication at a distance was difficult and expensive. One calculation at about the time the telephone came into wide use suggested that, without it, office buildings in the early 20th century would have had to become inordinately massive to accommodate the crowds of human messengers moving from one office, one floor to another via stairs and elevators. Talking on the telephone also established patterns of communication that were more personal, less dense and formal (de Sola Pool, 1977).

Television and the fragmentation of experience. Television offers another example. We think of it as a news and entertainment medium, developed to extend the popular media of film and radio further into the home. As such, of course, it has been wildly successful; over 90 per cent of all American homes have TV sets, a level of saturation that was reached after only a few years after television's introduction.

But there were other effects as well, many having to do with the social environment which television affected. Marshal McLuhan, for example, focused principally on television when he captured public imagination by claiming that we who have been intensely exposed to modern communication technology are now effectively separated from our "linear" forebears in our media-influenced style of telegraphic, aphoristic thought. Evidence demonstrating this has been slow to accumulate, but it has been suggested that television has induced a view of the world that breaks down traditional social constructs and mental barriers, placing political figures in a much different arena than they formerly

occupied, and also changing the relationships among parents and children, and among the sexes (Meyrowitz, 1985).

In one key area–national political life–television has been widely credited with altering fundamentally (and negatively) the type and depth of discourse about both candidates and political issues. From a pre-television focus on candidates' views, experience, and proposed policies, television has moved discussion of campaigns to a concentration on polls and a kind of endless "who's in first place?" commentary; from a pre-television focus on issues of long-term national significance, television has shifted the emphasis to topics that are easily condensed to a seven-second sound bite and that have high visual impact.

The assembly line: The process technology that changed the world. The examples we have surveyed so far have all regarded hardware or devices. Do process technologies also have unforeseen social consequences? A good example may be seen in the effects of mass production via the assembly line, certainly the essence of the nineteenth-century industrial revolution. Intended to rationalize the creation of manufactured goods, lower prices, improve quality, and thus provide the opportunity for high profits, assembly line production (called "the American system" by the British because of its place of origin). From rifles to canned meat to automobiles, the assembly line was based on a rational but hyperspecialized division of labor.

But while it was profitable, the assembly line also created some problems. The alienation of factory workers from their work became apparent by the middle of the nineteenth century; the anguish the system caused was a principal factor contributing to the development of socialism and Marxism, and to the creation of militant labor unions in the US and abroad. There were positive social effects, as well:

cheap mass-produced goods allowed common people to enjoy a standard of living unimaginable only a few years before. And the wider availability of such diverse products as canned food, plate glass, and shoes, delivered through new, assembly-line mechanisms such as chain stores and mail-order companies tended to mitigate the effects of poverty and, in the views of some, create a more democratic society (Boorstin, 1973).

The problem of the rear-view mirror. In all these cases, what those close to a technological change thought the technology was about was often surprisingly limited; as Marshal McLuhan put it, we tend to view the present through a rear-view mirror (McLuhan & Fiore, 1967). The immediate "purpose" of a technology–usually defined in narrow terms–appears to be manifest and uncomplicated, with few implications outside a narrow band of application- specific effects. At the time of Gutenberg, monks foresaw that they could and should continue the practice of hand-copying manuscripts because it was a morally valuable practice (Brann, 1979). When the patents for the telephone were offered to William Orton, President of the then-pre-eminent Western Union telegraph company, he remarked, "What use could this company make of an electrical toy?" (Aronson, 1977). Few of those who witnessed the development of assembly-line manufacture had any idea of the import of the changes–they were seen as marvelous, sometimes frightening, but rarely as threatening the social status quo (Jennings, 1985; Marvin, 1988).

But as technologies are assimilated, as people incorporate them into their patterns of activity, work, and daily lives, the social effects become more and more significant. Americans seem to have sensed this on some level, and this has led to a deep ambivalence, rarely openly discussed,

about the significance of technology: some see it as villain and scapegoat, others vaunt its role in contributing to social progress (on these matters, see Florman, 1981; Pagels, 1988; Segal, 1985; and Winner, 1986). Whether boon or bane, however, there can be little doubt that technology has a significant place in American thinking, and so the enthusiasm educators have shown for it as a panacea for problems of learning and instruction should come as no surprise. And while technology's social consequences in other domains are beginning to be examined carefully, its social impact on education has been largely ignored.

What Educational Technology Is Really About

We could, of course, become wildly speculative at this point, and simply advance all manner of extravagant claims regarding possible future social effects to emerge from applications of educational technology. Avoiding that temptation, let us examine briefly a few specific areas where there do seem to be some demonstrable social outcomes from using technology in education. A word of explanation and caution is in order here: in much of the discussion that follows, the focus is on the impact of computers and other methods for digitally encoding and processing information. This is not to say that other devices or a process approach may not be significant (but see Kerr, 1989, for an argument about educational technology that continues to place teachers–not devices or processes–at the center of education); they may, but I see the most significant social impact from educational technology as coming from the infusion of digital technology into education. Four particular areas of influence appear particularly significant: the organization of classroom life; the roles played by educators; the approaches taken by students; and the ways in which ed-

ucation is connected with the local and national economic and business communities.

Classroom organization and management: From uniformity to diversity. Computers in education already have had a significant impact on the ways in which classroom life can be organized and conducted. Before the advent of computers, even the teacher most dedicated to trying to provide a variety of instructional approaches and materials was hard-pressed to make the reality match the desire. There were simply no easy solutions to the problem of how to organize and manage activities for 25 or 30 students. Trying to get teachers-in-training to think in more diverse and varied ways about their classroom work was a perennial problem for schools and colleges of education (see, e.g., Joyce & Weil, 1986).

It has become clear that using computers can (though there is by no means any guarantee; much hard work is involved) free teachers' time in ways unimaginable only a few years ago. Several necessary conditions must be met: teachers must have considerable time to devote to figuring out what to do with the devices, and have a view of their own learning that stretches at least several years into the future; there must be support from the school or district; there must be sufficient hardware (not one machine per student necessarily, but at least several per classroom); and, preferably, a sufficiently flexible district policy about technology that gives teachers the chance to develop a personal style and a feeling of individual ownership and creativity in the crafting of personally significant individual models of what teaching with technology looks like (see Dwyer, Ringstaff, & Sandholz, 1990; Kerr, in press; Olson, 1988; Scheingold & Hadley, 1990; Wiske, 1988 for examples).

What has happened here in some situations is a quite

radical restructuring of classroom experience. This has not been simply a substitution of one model of classroom life for another, but rather an extension and elaboration of what is possible in classroom practice, perhaps the most significant such change in this century. The specific elements involved are several; they include: greater student involvement in project- oriented learning, increased learning in groups; a shift in the teacher's role and attitude from "being a source of knowledge to being a coach and mentor"; and a greater willingness on the parts of students to take responsibility for their won learning. Such changes do not come without their own costs, however, as many of the teachers involved can testify; dealing with a group of self-directed learners who have significant resources to direct and satisfy their own learning is not an easy job. But the social relationships within classrooms can be significantly altered by the addition of computers and a well-developed support structure.

Educators: From astrologers to consumers and producers of data. A further significant result of the wider application of technology in education is a shift in the way educators (teachers, administrators, specialists) collect and use data in support of their work. Education has long been criticized for being a "soft" discipline, and that has in many cases been true. But there have been reasons: statistical descriptions of academic achievement are not intrinsically easy to understand, and simply educating teachers in their use has never been easy; information in education has been seen as being more generalizable than it likely is, but there have been few ways to share even those bits of information that might be valuable across locations; and educators have not been well trained in how to generate useful data of their own and use it on a daily basis in their work.

In each of these areas, the wider availability of computers and their linkage through networks can make a significant difference in educational practice. Teachers learn about statistical and research procedures more rapidly with software tools that allow data to be presented and visualized more readily. Networks allow sharing of information among teachers in different schools, districts, states, or even countries; combined with the increased focus today on collaborative research projects that involve teachers in the definition and direction of the project, this move appears to make educational information more readily shared. And the combination of easier training and easier sharing, together with a reemphasis on teacher education and the development of "reflective practitioners," indicates how teachers can become true "producers and consumers" of educational data.

Indeed, the ways in which information is (or is not) shared within schools and districts to a large part defines power and political climate in those institutions. When information is distributed more widely, and understood by those who see it, then power must shift and become more diffused.

Students and the conflict between activity and passivity. Technology provides a contrasting set of imperatives for students' work in school contexts. On the one hand, as noted above, students are often the beneficiaries of a considerably modified school environment, one in which there is more flexibility, greater variety, and more possibilities for individual work and individual attention from the teacher. The opportunity to engage in collaborative projects of various kinds is attractive to students, as are the chances that technology makes available to work with other students remotely through telecommunications links.

But technology may also bring some negative consequences for students. The fragmentation of attention spans with 15 second commercials (when early film makers thought of 7 seconds as the minimum length of time a single *shot* could be presented on-screen!), combined with the all-pervasive assumption that "TV is entertainment" have created a situation which educators have yet to really recognize, much less address (Greenfield, 1984; Kubey & Csikszentmihalyi, 1990; Salomon, 1984).

Indeed, the real import of showing such TV-based news programs as Whittle's Channel One and CNN's News Room in classrooms may have less to do with the much-discussed negative impact of requiring students to attend to advertising and more to do with the fragmentation of attention and increased passivity that television viewing seems to promote. If schools are places in which active thought is to be fostered, then we should wonder why schools and parents have so willingly invited increases in students' exposure to media that may easily generate passivity. If continued over time, this increased passivity may have a strong and negative impact on American political and social life.

Schools and communities: From "in" to "of." Interestingly enough, a further consequence of the spread of technology into education may have to do not with schools themselves, but with the relationships between schools and their surrounding communities, and particularly between schools and the businesses that employ their graduates. It is not surprising that businesses have for years seen schools in a negative light; the cultures and goals of the two types of institutions are significantly different. What is interesting is what technology does to the equation.

Schools are, in industry's view, woefully undercapitalized. It is hard for businesses to see how schools can

be so "wastefully" labor-intensive in dealing with their charges. Thus, much initial enthusiasm for joint ventures with schools and for educational reform efforts that involve technology appears, from the side of business, to be simply wise business practice: replace old technology (teachers) with new (computers). This is the initial response when business begins to work with schools.

As industry-school partnerships develop, businesses often develop a greater appreciation of the problems and limitations schools have to face. (The pressure for such collaboration comes from the need on the part of industry to survive in a society that is increasingly dominated by "majority minorities," and whose needs for trained personnel are not adequately met by the public schools.) Classrooms, equipped with technology but also with teachers, appear more as "real" workplaces. Technology provides ways of providing better preparation for students from disadvantaged backgrounds, and thus is a a powerful support for new ways for schools and businesses to work together.

Business is not all of a community by any means, but the competitiveness of American students and American industry in world markets are an increasing concern. As technology improves the relationship between schools and the economy, the place of the schools in the community becomes correspondingly strengthened.

Conclusion: Educational Technology Is about Work in Schools

What educational technology seems to be about, then, is the work done in schools: how it is defined, who does it, to what purpose, and how that work connects with the surrounding community. Its direct effects on instruction, while important, are probably less significant in the long

run than the ways in which teachers change their assumptions about what a classroom looks like, feels like, and how students in it interact when technology is added to the mix. Students' learning of thinking skills or of factual material through CAI programs may ultimately be less significant than whether the new technologies encourage them to be active or passive learners, active or passive participants in the civic life of a democratic society. If technology changes the ways in which information is shared within a school, it may thus change the distribution of power in that school, and thereby alter fundamentally how the school does its work. And finally, technology may change the relationships between schools and communities, bringing them closer together.

These processes have already started. Their outcome is not certain, and other developments may eventually come to be seen as more significant than some of those discussed here. Nonetheless, it seems clear that the social impacts of both device and process technologies are in many cases more important than the purely technical problems that technologies are ostensibly developed to solve. What we need to do is pay more attention to the often puzzling social changes we can discern through the windshield, and pay less attention to the familiar (but ultimately unpromising) terrain of instructional effects we see in rear-view mirror.

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VALUES, INQUIRY, AND INSTRUCTIONAL TECHNOLOGY: EXPANDING OUR HORIZONS

Eunsoon Kwak
The Ohio State University
Gary J. Anglin
University of Kentucky

Many people today assume that knowing more will bring about a better society. These proponents of knowledge believe it will provide us with more choices, ultimately giving us more control over our lives. Development of new theories, it is argued, will automatically lead to better practical situations. In this sense the advancement of knowledge is the precondition of praxis which will result in a better, and just, society.

The same assumption can be made with respect to instructional design and the public schools. Advancement of instructional theories is supposed to bring an improvement of actual classroom learning. However, it seems there is increasing argument implying that the impact of instructional design and technology on public education is trivial (Clark & Solomon, 1986; Cuban, 1986; Heinich, 1984; Olson, 1974; Reiser & Salisbury, 1991). Teaching practice in todays schools is quite similar to teaching in the earliest public schools (Cuban, 1986). Our current instructional theories are not the panacea which many people in instruction and curriculum in the sixties excitedly predicted (Finn, 1960; Tyler, 1949). For example, Finn (1960) considers it inevitable for technology to extend into the instructional

process because technology and science have no limit and constantly extend into new areas. Finn believed that advanced technology in education will influence the classroom dramatically, it will produce more opportunities than ever before, and all citizens will be equipped with the technical and scientific knowledge which are necessary to an advanced technical society.

While reform movements based on such beliefs as Finn's come and go, the school remains, unchanged, independent from outside reform (Cherryholmes, 1988; Cuban, 1986). The reason for this gap between instructional design and teaching has been examined by many researchers (Clark & Solomon, 1986; Cuban, 1986; Heinich, 1984; Kerr, 1989). Some agree that the field needs more basic research firmly based on the scientific paradigm (Clark, 1984). Still others put importance on developmental studies of instructional design and technology, rooted not in traditional education, but in technology at large (Heinich, 1984, 1985).

Some critics point out that instructional design and technology is mainly oriented to technological and scientific superiority as opposed to practical reality (Bowers, 1988; Cherryholms, 1988; Cuban, 1986; Nunan, 1983). Technical solutions to instructional problems focus on knowledge acquisition, which usually means the successful achievement of behavioral objectives by the student, and is primarily concerned with efficiency of learning as measured by standardized test results and cost-effectiveness. The very assumption which values technology and science causes a gap between instructional design and actual teaching.

There is also a tendency for many instructional technologists to consider instructional design as value neutral. It is said to be value free because most instructional theories are scientifically oriented, emphasizing theorists' po-

sitions as "disinterested"– delineating objective knowledge which can be true regardless of its context. According to Finn (1960), for example, it is this objective knowledge which will accomplish productive learning in today's modern civilization. However, some theorists do not accept the assumption of value-free instructional design because any theorizing action itself starts with a researcher's specific interest (Berstein, 1976; Cherryholmes, 1988; Clark & Florio-Ruance, 1983; Polanyi, 1966). Like all other approaches, the scientific way of knowing is also based on the beliefs, authority, and commitments which are tacit (not codified) in nature (Polanyi, 1966).

In this paper we discuss the inherent value orientation of instructional design and technology. Influenced by scientific ways of knowing, most professionals in instructional design and technology separate their theorizing from its value orientation. They have searched for instructional theories which are value neutral and, hence, applicable in any practical application. Theorizing is considered to be disinterested action for finding objective and generalizable knowledge. Based on the notion that any perspective has its own value orientation, the values embedded in the field of instructional design and technology will be discussed. We will examine "knowledge proper" in instructional design, the instructional design curriculum in higher education, the ontological reference to theories of instruction, the relation between instructional theory, design and practice, conflicts of interest between theorists and practitioner, and the importance of using many ways of knowing to expand our knowledge base.

Knowledge Proper in Instructional Design

Schulman (1988) points our that "what distinguishes re-

search from other forms of human discourse is the application of research methods" (pp. 15-16). Primary methods (i.e. ways of knowing) applied in educational research include: historical, philosophical, ethnographic, case study, survey, comparative experimental, and quasi-experimental (Jaeger, 1988). In this section we argue that our understanding of instructional design and technology is partial because the mainstream theoretical background and conception of the field lean toward a specific mind-set which values a scientific way of knowing (comparative experimental and quasi-experimental) over other ways of knowing. Basic theories of instructional design are considered scientifically developed, being prescriptive, manipulable, and generalizable for the control of teaching practice. This belief is well expressed when we examine two definitions of instructional technology:

- "Educational Technology is the application of scientific knowledge about learning, and the conditions of learning to improve the effectiveness and efficiency of teaching and training" (Richmond, 1970; p. 5).
- "a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on the research on human learning and communication and employing a combination of human and nonhuman resources to bring about more effective instruction" (Clark & Salomon, 1986; p. 464).

Also, this advocation of a scientific way of knowing is explicitly indicated when Finn (1953) talks about the instructional technology field as a profession. Finn claims that the

profession should distinguish itself from traditional teaching because it is based on scientifically developed knowledge. To make his claim explicit, he states that

> the most fundamental and most important characteristic of a profession is that skills involved are founded upon a body of intellectual theory and research . . . . The antithesis to a profession is an avocation based upon customary activities and modified by the trail and error of individual practice. Such an avocation is a Craft . . . (Finn, 1953; p.8).

Advocates of a science of instructional design believe that a science of design will improve learning in the classroom. However, when we evaluate our instructional theory and instructional design knowledge base will it withstand the scientific cannon (Berstein, 1976)? For example, by deconstructing Bloom's taxonomy of learning objectives, Cherryholmes (1988) argues that this well-known theory has a weakly scientific foundation as there is no empirical evidence to support Bloom's hypotheses that knowledge can be taught in a discrete manner. Bloom attempts to classify the knowledge without any verification, even though he admits that he is trying to classify the phenomenon which "couldn't be observed or manipulated in the same concrete form as the phenomena of such fields as the physical and biological sciences" (Bloom, 1956; p. 5). By assuming that knowledge can be developed and categorized by experts, Bloom establishes hierarchical relations from experts to teachers to students. Even though Bloom has made a major contribution to the field of education through his explorations of different kinds of learning, he chooses to emphasize knowledge which is "external", which

can be delivered in a separate discrete manner while focusing out the implicit aspect of knowledge which should be understood as a whole. The purpose of Bloom's theorizing was to solve the communication problem among administrators, teachers, and parents and to provide a framework for developing test items. In this respect, Bloom's taxonomy of learning objectives has neither firm scientific foundations nor represents classroom learning because it covers only a certain aspect of learning.

By deconstructing Bloom's taxonomy of learning, Cherryholmes leads us to think about our own theories. This discourse enables us to look at what is emphasized and reduced in a theory for the sake of the theory's chief tenets. Considered this way, we cannot totally lean on any instructional theory because of its partiality. Rather, we, as instructional designers, may develop a more thorough understanding of our actions by comprehending the incompleteness of our own theories of instruction.

Based on the belief that instructional design has (or should have) a firm scientific foundation, instruction is viewed as a rational product which can be divided into parts. Using a systems approach, instruction is divided in phases: design, execution, and evaluation (Nunan, 1983). This division makes possible the application of scientifically developed theories to instructional practice. The systems approach emphasized here is at a micro-level, which divides instruction into parts and which make it possible to define every step of the instruction in tangible and measurable terms. While emphasizing the micro-level of the systems approach in instructional design, we may overlook another aspect of the systems approach, that is, the macro-level. Hoban (1977) suggests that there are two classes of systems approaches, mechanical and social.

Unlike the mechanical systems approach which focuses on physical aspects, a social systems approach examines the patterns of the organization of people, power, authority, rules, and regulation of the flow of operations. These two different classes of systems approaches are conflicting in reality (Hoban, 1977). Hoban claims that one dominates the other; it is the mechanical level of systems approach which is dominant in the field of instructional design. The social level of the systems approach is rarely focused on in instructional design.

However, if we still believe that the functions of schooling are more than the transmission of information, social, hidden learning is often considered as important as codified learning. This kind of learning can be studied using the social systems approach. For example, Dreeben (1968) examines what is learned in schools by analyzing the hidden curriculum. He claims that students learn social norms which are critical for adulthood in an industrialized society, and this learning occurs by experiencing the structure of school organizations. The experience that schools provide to students puts emphasis on independence and achievement, by covertly connecting negative connotations to opposite norms–that is dependence, cooperation, and uniqueness and by continuously excluding chances to learn about such norms. This hidden learning is critical for students to prepare for an information age society.

However, successive failure in learning such norms creates negative self-images for some learners. The irony is that this kind of learning is primary for a democratic society, but, on the other hand, it reinforces the bureaucracy. We can study this kind of hidden learning using the macrosystems approach which makes it possible to look at school learning with broader perspectives. The macro-level sys-

tems approach does not receive much attention from professionals in instructional design, even though it interacts with the micro-level systems approach and often becomes a determining factor in the success of the micro-level approach (Hoban, 1977; Nunan, 1983).

We have argued that inquiry in instructional design and technology has progressed using limited ways of knowing (primarily a scientific way) and that we usually apply systems approaches for the design of instruction at the micro-level (technical). Given this state of affairs, teachers' values, interests and ideas concerning instructional design are rarely incorporated in our definition of instruction as a rational product (Cuban, 1986; Kerr, 1989; Nunan, 1983). In many cases, teachers' interest in instruction concerns daily practice rather than description and prediction of outcomes. Their teaching focuses on actual interaction with students rather than on various instructional resources. In the teachers' view, teaching is personal, sacrosanct, and always contains unpredictable and ambiguous parts (Nunan, 1983). Teachers have to make immediate decisions as their teaching "unfolds" in the classroom. In this view, teaching is craft and can be accomplished by "apprenticeship". Our current definition of instructional design (micro-level) does not include many concerns that teachers have concerning instructional design at the macro-level.

Graduate School Curriculum in Instructional Design and Technology

The attitude to value technology and science and to conceive instruction as a rational product is rooted in the mainstream scientific paradigm. This orientation reflects current graduate school instructional design and technology curriculum. It seems that this scientific orientation has le-

gitimizing power to select what is proper study and what is not in the field. Significantly influenced by research in the behavioral sciences, much of the research in instructional design involves

> the definition of the problem, the development of hypotheses, the creation of materials and methods designed to test hypotheses, the implementation of the research, study, the analysis of the outcomes of the research relative to the hypotheses developed for the defined problem, and the conclusion of confirmation or disconfirmation of hypotheses (Hannafin, 1986; p. 24).

Even though there can be many possibilities for research in instructional design, most of the research incorporates experimental methods.

It is not our primary concern to argue the strength and weakness of the scientific paradigm. It is certainly a viable way of knowing. Yet the model greatly influences what is appropriate or acceptable research in the field (Bernstein, 1976). The scientific way of knowing has legitimizing power as it influences graduate school curriculum and publication policies of journals. For example, graduate school curriculum in instructional design emphasizes the experimental rigor, strict hypothesis testing, and technical writing (Hannafin, 1986; 1991). Many professors trained in this way train their graduate students to use the same methodology. Studies based on other ways of knowing are interesting but are not regarded with the same importance as those based on a scientific way of knowing.

Promotion and tenure criteria also influence the mode of inquiry taught and used by researchers in instructional design. Pursuing research opportunities other than those

oriented to technical interest (Hobans' micro-level) may be exciting but potentially risky for those seeking tenure and promotion.

Finally, based, in part, on the focus of graduate school programs and the requirements for promotion and tenure, proportionately more experimental studies have been published in professional journals (Hannafin, 1986). Experimental research emphasis is implicitly perpetuated by the dominance of experimental studies in professional books and journals.

In summary, the attitude to value scientifically oriented studies significantly influences graduate students (Bernstein, 1976; Hoban, 1977). Based on the ways of knowing they are taught, the research approaches modeled by their professors, and the specific focus of published studies, graduate students go through important primary socialization which in turn has a great impact on their conception of knowledge, inquiry, and the field.

Ontological Reference of Knowing

So far, we have discussed the partiality of our knowledge of instructional design based on the scientific paradigm. We have also discussed the effect of our focus on a scientific way of knowing has had on the graduate school curriculum in instructional design and technology. In this section, we will discuss the limitations of the theoretical orientation toward an epistemology which emphasizes rigorous description of learning and prescriptive instructional theories.

Most of the instructional design models developed emphasize the rigorous descriptions of possible learning for communication and measurement purposes (Bauchamp, 1975; Reigeluth, 1987). While emphasizing description of knowledge, they often undermine ontological aspects of

knowing which focus on what is, rather than on a *description* of what is. It is this explicit and rigorous description which often makes us confuse the essence of knowledge with its appearance.

Ontological ways of knowing are well described by Polanyi (1966). Polanyi asserts the importance of tacit knowledge. He argues that knowing is understanding the tacit parts of knowledge by attending to the functions of its particulars. But if we pay attention to only the particulars, which are explicit in reality, their functions are not understood in light of the entity we wish to examine. Therefore, Polanyi (1966) argues that we "dwell" in a certain phenomenon in order to understand the continuum of its explicit particulars and tacit background. In order to understand the tacit dimension of knowledge, we need insight and commitment to look at its particulars in meaningful ways. Science starts with insights and imaginations which can make connections between the particulars and its tacit background meaningfully. In order to have these critical insights or imagination, we have to "dwell" in a certain phenomenon which demands more than the precise description.

The importance of "dwelling" in the phenomenon for sufficient understanding is also well expressed by Van Mannen (1980). The most critical aspects of understanding pedagogy lie in the experience of love toward their offsprings in daily lives, not in any psychological or philosophical description of what pedagogy is.

The discussion or description of pedagogy in relation to philosophy or psychology is secondary to the understanding from "dwelling" in the pedagogical life.

By claiming the impossibility of accounting for the nature and justification of knowledge by explicit descriptions

of the particulars without invoking deeper commitment, Polanyi disagrees with mainstream social scientists who assert that they are disinterested outsiders of their knowing actions. Of course, an attempt to exclude personal prejudice and bias is critical in any attempt to know. However, we, as human beings, start the very actions of knowing with our own interests, whether they are scientifically oriented or not. The scientists' commitment and craving for success are well expressed by Polanyi as he describes the scientists' passion–one strong enough to risk failure even which seeking repute of their theories.

However, instructional designers have to describe possible instruction as they develop models away from the classroom. In most cases they do not "dwell" in a certain classroom. Their purpose is to control classroom learning by predefined instruction and evaluation based on prescribed objectives–including developing behavioral objectives self-sufficient enough to stand alone regardless of their context. The frustrations surrounding developing such objectives and the scarcity of such behavioral objectives show the difficulties in ignoring tacit ways of understanding. The real influence of behavioral objectives lies in how they implicitly value explicit descriptions over tacit knowing, decontextualized forms of knowledge over local knowledge, and central control over local control (Nunan, 1983).

The very act of putting emphasis on descriptions of knowledge reflects the instructional designers' value toward scientifically developed knowledge over practically developed knowledge. Many instructional designers believe that it is theory which should guide practice (Clark, 1984; Clark & Salomon, 1986; Heinich, 1984; Stewart, 1985). In this respect, the relationship between theory and practice is understood in a hierarchical order. The following expression

"Science Finds, Industry Applies, Man Conforms" well represents the flow pattern of theory and practice in many instructional designers' understanding of their roles as theorists (Taylor & Johnsen, 1986; p. 220).

The view of superiority of theory to practice is amplified when we consider knowledge as objective and decontextualized, and not related to any particular value orientation. Theorists proceed as if they are searching for "value free" knowledge which is true regardless of its context. In this way, a theory can be used to guide many practical situations. This view of theorizing is well expressed in the assumptions of theories in behavioral sciences. It is assumed that theory should be tested using the methods of science and one should exclude any personal values (Skinner, 1982).

The goal is to develop objective knowledge which is generalizable to many contexts. In order to find such knowledge, it is argued, theorists should be distanced from practice (Heinich, 1984; Skinner, 1982; Stewart, 1985). Otherwise, theorists may project their own personal interests either intentionally or unintentionally.

However, we believe that there is no such thing as "value free" knowledge in the social sciences, including instructional design and technology, which can be generalizable to any context. To look at theorizing as value-neutral action actually represents the theorists' value of a scientific way of knowing over other ways of knowing. Theorizing itself starts with a theorist's specific hypotheses that are closely related to their interest. Even though we attempt to set our own bias and prejudice aside while we are involved in theorizing actions, the starting point of theorizing itself is affected by the theorist's own interests and values.

For example, Heinich (1984) emphasized the "disinterested" theorists' position by suggesting that instructional

technologists should remove all their personal interests because possible automation of instruction may result in losing their jobs. However, this claim itself is clearly not value free. This reflects Heinich's value on the delivery of subject matters as the goal of instruction. What he emphasized is how, using technology, we can deliver instruction in a cost-effective manner. There is a particular ideology behind such a process of knowledge acquisition. The research hypothesis that automation of instruction can replace teachers reflects the researcher's interest as much as the research hypothesis that teachers have a specific role which the machine cannot imitate. It seems almost impossible to separate theorists' values and interests from their professional work. Theorizing is not a value-neutral activity. It starts with specific interests with an underlying value orientation. Most theorizing actions in instructional design are focused on a particular area which emphasizes the delivery of instruction in a cost effective manner, using today's instructional technology. It this regard, it can be said that there is no clear separation among theory, ideology, and power. In reality, nothing can exist in a decontextulized situation because every theory is understood in reference to its social and historical context.

Another reason to consider theory and practice as separate phenomena is that theorizing action should not be influenced by any authoritative point of view or existing power structure (Heinich, 1984; Stewart, 1985). The existing power structure of practice will set the limitation of theorizing. For example, Heinich (1984) states that in practical classroom situations, instructional designers cannot find ideal ways to use technology in instruction. Technology is usually pushed to the edge of primary classroom instruction where it does not threaten the existing power

relationship between teachers and textbooks. Acceptable instruction, then, supports the established position of textbooks and teachers. On the other hand, it is unacceptable to accept the existing relationship between textbooks and teachers. The very concerns of practice turn out to threaten the existence of instructional design because the only way to get into practice is to keep supporting the position that it is "ok" not to use technologies of instruction.

Many people in the field believe that this matter can be solved by thorough scientific theorizing rather than by looking at this power conflict with other perspectives (Stewart, 1985). This attitude is shared with many social scientists who believe problems caused by technical development, *e.g.* pollution, can be solved with more advanced technical development (Bowers, 1988). These attitudes come from the ideology which assumes knowledge is apolitical, objective knowledge which can cure every problem we have. The very approach of many social scientists to avoid politics results in reinforcement of the status quo. This is unlikely to change unless we acknowledge that ways of knowing and instructional practice are always confounded with ideology and power.

Conflicting Interests

Ideally theory and practice should compliment each other. For example, theories of instruction can give some guidance for actual teaching practice, and these theories should leave much room for practical and contextual knowledge. This compensatory role often fosters conflict according to the interests of practitioners and theorists (Cherryholmes, 1988). Many theorists' interests are technical because they seek generalizable knowledge. On the other hand, many practitioners' interests are practical because

what they are searching for is concrete and specific knowledge which is not necessarily generalizable to other situations. This difference in interests often makes it difficult to apply general theories to a specific practice. This conflict of interests is well pointed out by Clark & Florio-Ruance (1983). Different interests exist among teachers, administrators, and parents in schools, as well as between researchers and teachers. Even when researchers and teachers look at the same issue, such as promoting writing skills in the classroom, the answer they seek is different according to their positions. While administrators are looking for confirmation of theories and authoritative answers from researchers, teachers and student teachers are looking for answers from other teachers who are involved in the research; they are more interested in solving instantaneous problems which occur in the classroom.

When applying instructional technology to the classroom environment, we see the same conflict (Cuban, 1986; Kerr, 1989). For example, while teachers are looking for teaching materials which are durable as well as flexible, ones that can withstand the unpredictable nature of the classroom, academicians and business people are more interested in applying and disseminating advanced technologies in the classroom. Also many teachers do not use teaching materials and technologies according to the developer's interest. For example, teachers use instructional television after lunch during afternoon lessons, when students' and teachers' biorhythms are at a lower level than they are in the morning (Cuban, 1986).

Researchers in instructional design should understand teachers' interests rather than ignoring them by separating theory from practice. Designers should search for solutions which improve classroom environments. Researchers

should not lose contact with classroom learning situations if their theories are to improve ways of learning. The significance of practical theories is discussed by Sanders & McCutcheon (1986). Since the aims of theorizing are tied to practical progress, practitioners' themselves should also be involved in theorizing activities. Theory and practice are reciprocal and should be integrated.

Instructional Design and Technology as Value Laden Actions

By emphasizing scientifically developed theory over practical knowledge and by focusing on epistemological knowledge over its ontological reference, many instructional designers follow western cultural orientations which value rational thinking over contextualized thinking–tangible productivity over contemplative solution. In this mindset, the flow pattern of knowledge is hierarchical from academics to students; academicians will develop knowledge, instructional designers will organize such knowledge in a somewhat ready-to-deliver manner according to school policies, teachers will deliver this ready-made knowledge, and it is students who are supposed to take (consume) such knowledge. In this view, the learners' minds are understood as "blank-slates". Learners are knowledge receivers and teachers are "facilitators", delivering somebody else's knowledge.

It is not the instructional designers' choice to change the roles of teachers or students. Such results, however, come inadvertently whenever someone tries to develop and implement instructional models based only on the scientific paradigm. Developed this way, instructional design is value-laden; it is not characterized by value-free activities which develop apolitical knowledge of apolitical phenom-

ena. The very action by which researchers claim political neutrality results in their supporting the status quo. By denying its value-laden aspects, instructional designers lose the chance to see what is amplified and what is reduced in the actions of instructional design and create a barrier to the expansion of knowledge in our field. We need to use all possible ways of knowing.

The value issue when theorizing is well expressed by Polanyi (1966). He states that "Whenever new originality is in action, it brings new value; it breeds them tacitly by implication. In this respect we cannot choose explicitly a set of new values but must submit to them by the very act of creating or adopting them" (Polanyi, 1966, p. xi). We cannot choose a value system because it is tacit; it comes in an implicit way, and it creates an environment which is so much taken for granted that the "environment itself becomes almost invisible to those who live within it" (Nunan, 1983; p. 118). Thus we are not in control of value orientations which explicit new knowledge brings, because they are often invisible and come inadvertently. The impact of embedded values on learning is well shown in studies done by Johnsen & Taylor (1991). By searching the origins of instruction historically, the authors show how these origins influence today's students' view of knowledge. Today many students view their learning as external–something that happens to them. Over time the responsibility for learning has shifted from students to teachers and finally to expert instructional designers. This change of the locus of control maintains the view of knowledge as external; it is always developed by somebody else, and the students' job is to consume it. The result of such a perspective reinforces the notion that students cannot be creative and curious by themselves. It may not be an overt intention of instruc-

tional designers to define knowledge as fixed, and they do not codify learners as consumers of knowledge. But such notions follow implicitly and inadvertently as instructional technologists try to develop a system which delivers the "best" knowledge to students.

This unplanned impact is so profound that it continually affects attitudes of students toward learning. The underlying value system of mainstream social science has had a significant influence; we are affected by it everyday whenever we are forced to express what we know according to scientific rigor, whenever our interest in the field of instruction is pushed to conform to acceptable norms, and whenever we try to control the classroom through rigorous and precise prescription.

Conclusions

It is time for instructional technologists to examine the values which underlie the modes of inquiry that they use when developing prescriptive instructional design approaches and models. Assuming that any way of knowing is value neutral is dangerous because such a perspective limits the possibilities for developing our knowledge base. For, example it restricts our exploration of tacit knowledge, and local practice. Instructional theories and design models developed using a scientific way of knowing are not value neutral. Particular theories and models overtly and covertly amplify certain views of how knowledge originates. We falsely assume that all knowledge proper in the field is objective, generalizable knowledge which can help us control instructional practice.

Using comparative and quasi-experimental methods, we have significantly increased the knowledge base in the field. However, it is now time to expand our horizons and explore

and use different ways of knowing and identify the values which underlie each particular method of inquiry . We can then develop a more complete view of our field.

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RECLAIMING VIRTUE: PHILOSOPHY IN THE FIELD OF EDUCATIONAL TECHNOLOGY.

John C. Belland
The Ohio State University
Philip L. Smith
The Ohio State University

In the modern western world we seem to divide things into two categories. There are things that belong uniquely to the person, things like feelings and emotions that we sometimes refer to disparagingly as subjective, and there are those things that belong objectively to the world, nitty-gritty, practical things which are instrumental in any actual accomplishment. Whereas our premodern ancestors focused almost completely on the subjective, we separate things into either category and, depending on the precise nature of our concern, proceed to regard one category as operative and the other as irrelevant.

There can be no doubt where the field of educational technology stands on this matter. Its very name suggests a dedication to that which is concrete and particular. Vagueness and ambiguity are its enemies, efficiency and effectiveness are its goals. This field prides itself in being discussible apart from ends or values. It might facilitate ends or values, but it deals with objective means that in no way depend on normative goals. To mix the two would be considered ideological, in the pejorative sense of that term. Good technology, like the good science on which it is based,

must remain essentially value-free in order to preserve its commitment to reason.

All this is to say that, according to the popular view, the only values necessarily associated with sound educational technology are instrumental. It manifests no internal values of its own. Like all good technology, it is without inherent purpose. But wait! Shouldn't we see this as a very strange claim coming from a field of professional education focused on teaching and learning?

If education is inherently a normative enterprise, we would expect its various subfields to reflect its mission, its vision of what is worthwhile, or the set of virtues, if you will, that education is required to promote. Why is this posture lacking in the official posture of educational technology? The obvious answer is that for many the essence of these fields is technology, not education, and that this fact precludes the kind of normative commitment we find in education itself. Not only is this said about the field of educational technology, but nowadays it is assumed that a profession must profess expertise, and that to do this it must sanction a policy of neutrality. Lacking a justified claim to expertise, a profession will have neither status nor influence, and ultimately will lose its credibility. In this regard educational technology is no different than any other field in professional education. It must defend itself as a salable clinical specialty or else disappear.

Yet there is another response that can be made which, while it does not negate these explanations, goes considerably deeper. Education in this or any other culture attempts to promote what is good. What the term "good" might denote is, of course, always problematic. But there is little dispute that goodness must somehow be incorporated into the educational process; indeed that it is at the heart

of that process. What would education be if it were not the pursuit of virtue? But here is the rub. Virtue may focus on either the ends or the means of our actions, and it may have either a moral or a non-moral connotation. Understood as a proper moral condition, virtue takes on a heavenly tone. As an instrument of power, virtue is decidedly practical.

The problem arises when these two senses of virtue are seen as mutually exclusive, or where one sense obliterates the other. There was a time perhaps when these two kinds of virtue were integrated into one. Some have claimed this happened during the period of ancient Athens or in Homer's day. Regardless, by the Renaissance the distinction between these two different kinds of virtue was well on the way to being considered absolute. While the distinction sometimes has the effect of generating a useful dialectic where the active sense served to criticize and reform the moral sense, allowing for genuine progress, the results have not always been sanguine.

A classic celebration of the dissection of virtue is found in the work of Niccolo Machiavelli. In Machiavelli's day the political crisis of Italy and the moral crisis of the Church led people to lose confidence in themselves and in their power to live well in the world. Machiavelli's stress on personal independence was a response to this condition. He saw trust in outside powers rather than one's own as the sickness of Italian polities. His basic objection to Christianity, for example, was that it turned and individual's effort away from the world where people actually live.

To oppose this, he would say to the individual, trust in yourself and operate in the natural world of which you are a part (tr. Ricci, 1950). His message was defiant of despair. By secularizing virtue he showed that fortune need not be man's fate (cf. 81, 91). This was the good news.

The bad news was that Machiavelli's overriding interest in effective action belittled any concern for what was morally right. He believed that virtue was best embodied in the idea of military power. In Machiavelli more than in any other Renaissance writer, we see the popular conceptions of virtue measured against this military model and can see them discarded when they do not acknowledge the primacy of physical force. We are told that:

> how we live is so far removed from how we ought to live, that he who abandons what is done for what ought to be done will rather learn to bring about his own ruin than his preservation. A man who wishes to make a profession of goodness in everything must necessarily come to grief among so many who are not good . . .(p. 56).

and from another passage:

> He who ponders well the whole question [of virtue] will find one thing that looks like virtue, which to follow would be his ruin, and another that looks like vice, which when followed brings his security and well-being (p.57).

Machiavelli admired the kind of animal instinctiveness that allows a person to become a natural force in the environment. He opposed reason when it weakens this power, which means to the extent that it suppresses or tempers the passions. The function of reason, in Machiavelli's view, is to order the passions so as to use their power more effectively. Reason, like virtue, is purely instrumental on this analysis. Indeed, it would be more to the point to say that reason is a virtue insofar as it has the power of technology to get us what we want.

In post-Renaissance Europe the disorder Machiavelli lamented gave way to something like the order he had desired. The agency of this change was a creation of which Machiavelli has often been called the prophet: the modern state. The governments of Europe gained more effective control of their territories, expanding and improving their administrative bureaucracies, and gaining a monopoly of violence through a centrally organized and controlled army. In this new situation the maintenance of political order seldom required the kind of unrestricted and audacious action Machiavelli prescribed for the prince. By the eighteenth century the rule of monarchies had produced such peaceful, ordered, and disciplined political units that Machiavelli's methods within the state were hardly appropriate. They continued on a grand scale only in relations between states. Thus, within the state the idea of moral virtue regained its former status and existed along side of, but not in relation to, the idea of virtue as effective action.

For example, Thomas Hobbes wrote that "force and fraud are the two cardinal virtues" in time of war. But in time of peace or within the peaceful state he denied this. He saw a clear separation between these two realms of virtue, the active sense presenting no Machiavellian challenge to the moral sense. The article on *Vertu* [Virtue] in the famous *Encyclopedia* of Diderot and d'Alembert reflected its purely moral sense. There virtue was described as "one, simple and unalterable in its essence, the same in all times, climes [climates] and governments"(p. 517). It was "the constant observation of the laws that are imposed on us." Virtue was an inner light, a sentiment given to all men by God, the foundation on which all human societies and all laws were built. While the article noted that there was an older sense of virtue that was tied to strength and courage,

and suggested that this was part of what virtue was, this aspect was not taken seriously. There is really nothing in the article to prevent the reader from equating virtue with goodness.

In a manner of speaking, this isolation of moral virtue is a tribute to the high level of civilization and order during the Enlightenment. But the vitality of the idea had been lost. It should come as no surprise then that when something like a Machiavellian approach to virtue reappeared, it was in the form of a man who was in revolt against the social and political order that had grown up in Europe since the Renaissance. Friedrich Nietzsche's (1844-1900) conception of virtue arose from his search for man's true self, a self buried under the coercive weight of inauthentic and oppressive conventions. His new man or "overman" was one who has "become what he is," (tr. Kaufmann, 1968) a declaration that served as the subtitle of Nietzsche's book *Ecce Homo*. True virtue, Nietzsche said, contributed admirable growth of the person, but this has to be sharply distinguished from conventional morality. Virtues are as dangerous as vices in so far as they are allowed to rule over one as authorities and laws coming from outside, and not as qualities one develops one's self. The latter is the only right way; they should be the most personal means of defense and most individual needs the determining factors of precisely our existence and growth, which we recognize and acknowledge independently of the question whether others grow with us with the help of the same or different principles.... The extent of which one can dispense with virtue is the measure of one's strength; and a height may be imagined where the notion of 'virtue' is understood in such a way as to be reminiscent of *virtu*— the virtue of the Renaissance free from moralic [sic] acid" (tr. Kaufmann, *The*

will to power, Secs. 326, 327). Nietzsche's idea of virtue revived many of the essential elements of Machiavelli's notion. Virtue meant power over one's self and one's environment. It depends on the self being in harmony with the natural, biological world. And one of its major components was the individual's freedom, i.e., independence.

The ideas of Nietzsche and Machiavelli are still different, however. Nietzsche was more radical. He repudiated the very institution whose discipline Machiavelli required most for virtue; that was the political community or the state. Machiavelli's idea of virtue suggested, and often actually lead to tyranny. Nietzsche, influenced as he was by the Enlightenment's commitment to extreme individualism, was convinced that only the person, the "single one," could find human self-realization. The state blocked the way. In this we find Nietzsche's dedication to the opposition of tyranny.

Earlier the development of the state had put an end, at least within the state, to Machiavelli's political kind of speculation about virtue. Now Nietzsche saw that domination by the state stifled the development of real virtue. In this there was both great insight and great irony. For however brilliantly Nietzsche illuminated the condition of modern man, he seemed to be unaware that in his celebration of virtue as anarchy he was, at least in potential, breeding tyranny, the very thing he hated most. Machiavellian virtue is an antidote to anarchy, not its protector. It contains within itself a willingness to sanction tyranny as a remedy for anarchy. Such was the lesson of the French revolution, and who knows how many smaller battles since, right down to the level of ordinary two person disputes, or even those battles we have with ourselves.

Perhaps with this last remark we can begin to see the importance of this kind of thinking for education. Insofar as

education is about virtue, we must face the question of what virtue means. If there was ever a time in our culture when we had the answer, that time has past. We live nowadays with the same kind of ambiguity that stirred the outrage of Machiavelli and Nietzsche. We invoke the moral sense of "virtue" when it is convenient. But the truth is that moral sense carries little real weight. No wonder then that practical people everywhere prefer effective action to moral virtue. Under the guise of technology and expertise, we find ourselves as educators increasingly dependent on virtue in the former sense. The reason is not just because we have a practical job to do, but because we have to teach our culture and we live in a world where power is the bottom line.

As educators and as a culture, we lack direction and purpose, like the pilot who radios back to the tower, "I'm lost but I'm making good time." We achieve our objectives, communicate in a variety of ways, design efficient and effective systems for learning and yet seldom examine any larger good which might be served by these efforts. What is needed, of course, is an integration of the moral and active sense of virtue, the kind of thing that people like Achilles were supposed to have had, tempered by our democratic and scientific sensibilities, if that is possible. But the more we work for this, the farther away we seem to be from achieving it. But what choice is there? To do nothing is to tolerate the vacillations between tyranny and anarchy that have plagued western culture since the Renaissance. Tyranny and anarchy, each in its own way, render ordinary moral virtue invalid and demand that we seek within ourselves a new foundation for our actions. Such is the lesson we might glean by looking at the history of the idea of virtue. And it sets the task before us.

As educational technologists and professionals interested in communicating through visual media, we owe it to ourselves, to our students, and to the culture we represent to aid in the struggle for a decent world. The image we usually present of ourselves as experts, as neutral implementers, as problem-solvers, represents a sort Machiavellian behavior on our part. If we fail to understand the context of our work, if we do not take responsibility for the social consequences of what we do, for its meaning and value, then we are promoting the very swings in our culture between oppressive control and wild release that as educators we are obliged to remedy. Insofar as we fail to understand what is at stake, we are a menace to the achievement of this task.

In the field of educational technology, the reintegration of the two components of virtue are of critical importance as technologists and educators debate the implementation of Whittle Communications Channel One. Is is good to exchange grants of equipment for the dissemination to students of television-style news and commercials? The grants of equipment will certainly get equipment into the schools. The programming will ensure that students watch well produced news segments and slick commercials. This gets a job done in terms of headlines and 10-second sound bites. It also ensures that advertisers of products which are sold to pre-teen and teen audiences will be given one more daily exposure to the targeted market. This is a vivid example of Machiavellian virtue. Is this a good which is good enough for educational technologists?

One would hope not. It would seem reasonable that schools should be places in which learners should experience ideas in depth, in which they are equipped with the knowledge and skill to criticize and reject television news as being an inadequate discourse about current events. One

would also hope that schools should be places in which learners should be able to evaluate ideas reflectively rather than places in which they are bombarded with prescriptions for instant gratification.

On the other hand, one ought not assume that schools need not confront modern communications technology as in Nietzschian asceticism. In fact, the public should raise the funds to provide television and computers configured in such a way that intellectual development is fostered rather than commercial interests patronized. Technologists and teachers should commit themselves to providing experiences to learners which not only provide information but also encourage the development of intellectual skills. These skills will help learners become critical viewers of television and critical evaluators of information in general. Such an effort would integrate both components of virtue and ensure that educational technologists keep their work focused on that which is truly virtuous.

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TECHNOLOGICAL VISIONS IN EDUCATION

Denis Hlynka
University of Manitoba
Chris Chinlen
University of Manitoba

Educational technology is often perceived within two traditional views. The one celebrates technology as a "social benison", while the other perceives technology as a villain. Educational technology derived from the positivist assumptions of the social sciences—sociology, psychology, communications, and management- –prides itself in being systematic, logical, precise, effective and efficient. Educational technology derived from hermeneutic, interpretive and aesthetic assumptions, on the other hand, focuses on discontinuity, the failure of technology, and a resultant move towards temporal truths and complexity, hybrid rather than pure elements, compromising rather than clean solutions, ambiguous rather than precise conclusions. The former view provides one set of social/cultural implications of educational technology, while the later provides a different set. A variety of paradigms have been proposed which can be useful in providing different lenses to conduct inquiry into educational technology. In exploring the impact of educational technology on culture and society, the answers we get depend on the models/ paradigms within which we ask the questions. This paper reviews some of the basic assumptions of these paradigms and proposes a postmodern alternative.

The Promise of Technology

God what a wonderful time to be alive!
–John Naisbitt, *Megatrends*

Here is one view of the future. This view might be called the technological promise. This view is exemplified by a 28 page planning document prepared by Alberta Education in 1987 titled *Visions 2000* which attempts to place technology into the educational project as it will be perceived by the year 2000. This is a glowing vision of the technological future. It is a future which promises that—through "intelligent application of technology to the provision of learning opportunities for children"—education will be more productive, more immediate and relevant, more powerful, more scientific, more individual, more accessible, more responsive, and more cost effective and efficient.

To make such a statement it is of course necessary to clarify what those goals of education are. *Visions 2000* identifies nine such goals. Students of the year 2000 will be able to:

> develop the ability to think conceptually, critically, and creatively; to acquire and apply problem solving skills; to apply the principles of logic and to use different modes of inquiry, master effective language and communication skills, including. . . communications technologies acquire basic knowledge, skills and positive attitudes needed to become responsible citizens learn about the interdependent nature of the world become aware of the expectations that will be faced as employees, employers, entrepreneurs and volunteers assume increasing responsibility for independent and

> continuous learning learn about themselves and develop positive self images develop constructive relationships with others develop cultural and recreational interests (p. 11).

This vision sees technology as the means towards reaching the goals identified, such that:

> virtually every home and school will be equipped with digital television and either a high resolution videotape machine or a recordable videodisc player; home and school computers will feature high-speed processing; two way satellite communication will be within the reach of every school; full text database systems will be available; expert systems will be available; high resolution holographic systems will be affordable by schools. (*Visions 2000*, p. 13).

The heart of the technological solution will be extensive computer- based workstations, local area networks and a wide range of hardware and software. All of this is predicted to be available by the year 2000 (now only 10 years into the future!).

This "promise of technology" position thus provides one set of cultural/social implications. This concept of technological progress combines the positivist view of process with product solutions. Many writers label this view as "technical."

The Dangers of Technology

> *Technology has muddled or even destroyed the traditional social compass.*
>
> –Ursula Franklin, *The Real World of Technology*

Here is a second view of the technological future in education. This view is the anti-technology thrust. This view questions whether the mad rush towards a technological society is necessarily inevitable or desirable. Focusing on technology in general, Florman (1975) has identified several key themes of the anti- technologists:

- Technology is a thing or a force that has escaped from human control.
- Technology forces man to do work that is tedious and degrading.
- Technology forces man to consume things that he does not really desire.
- Technology creates an elite class of technocrats and so disenfranchises the masses.
- Technology cripples man by cutting him off from the natural world in which he evolved.
- Technology provides man with technical diversions which destroy his existential sense of his own being. . . (pp. 21-30).

Even though Florman was writing about technology in the most general sense, nevertheless, several of his identified cautions may apply specifically to the social and cultural implications of educational technology.

- First, educational technology does act as an autonomous force, which seems to be beyond our control at times.
- Second, while educators' work may not necessarily be characterized as "degrading," certainly it has become more tedious. One needs only consider the amount of

time we now spend at the word processor, making sure margins, footnoting and layout are understandable to the language of word processing.

- Third, in order for schools to keep up, they must be technologically advanced. Whether teachers and administrators want to or not, they must be current with the latest hypercard, CAI or videodisc innovations. Additionally, the field of educational technology has become so complex and specialized that teachers can no longer develop their own instructional materials. They have to rely heavily on pre- packaged, off-the-shelf materials developed by educational technologists. As a consequence teachers are losing control of teaching content.

- Fourth, the elite which educational technology creates is that of those who have ready access to technologies and those who do not. It is not uncommon for one grade seven student to be able to hand in a typed (that is, word processed) assignment, due to access to a home computer, while his best friend cannot.

- Fifth, our reliance on technology in education becomes clear even in a trivial way whenever there is a power failure. Sometimes we are crippled by the simple lack of lights in a windowless classroom. Less often, the computer or film projector, or some other educational medium is an integral component of our teaching. Nevertheless, it is becoming less easy to teach "when the lights go out."

- Finally, all educational media provide a kind of technical diversion which can distance us from the real world. Television news on the one hand makes the

whole world into a village, but on the other hand, we become less knowledgeable about our own backyard, and gain a confused sense of values and priorities. Because knowledge is constructed, it is constructed within a value system which is not transparent.

Paradigms for the Study of Educational Technology

The two views presented above, positive and negative, have profound social and cultural implications. In order to consider these implications for educational technology, it is necessary to turn to a discussion of the ways existing paradigms or world views currently focus educational research. These paradigms provide us with sets of values and epistemological assumptions which will allow for alternative ways of looking at reality.

There seems to be no agreement among practitioners regarding the most appropriate paradigms to guide the inquiry process (Chinien, 1990). The current discourse has been so vigorous such as to suggest a tone of debate and battle, on what Gage (1990) has termed "the paradigm wars." The field of educational technology is characterized as being dominated by a paradigm split. This paradigm split has been typically characterized by a series of binary oppositions: art/science, qualitative/quantitative, or naturalist/rationalist. This disagreement which was once uniquely centered on a matter of advantages and disadvantages of quantitative vs qualitative methodologies, is now more focused on the fundamental differences in the basic axiomatic assumptions of competing paradigms.

One of the most useful frameworks we have found within which to hang these alternative paradigms is that trichotomy (technical/practical/critical) proposed by Habermas (1971). According to Habermas, this trichotomy provides three knowledge-

constitutive interests. Habermas suggests that there are three ways of conceptualizing inquiry. Schubert (1986) and Aoki (1986) have extended this framework into curriculum theory, while Hlynka and Belland (1990, In Press) have adapted the trichotomy into educational technology. This view provides three distinct paradigmatic options.

The technical paradigm focuses on "the ethos of control as reflected in the values of efficiency, effectiveness, certainty and predictability." (Aoki, 1986). This paradigm is broadly synonymous with the concepts and accompanying world views of positivism quantitative methodologies, means-ends analyses, and rationalistic modes of inquiry. Following a technical model, researchers would pose questions such as the following:

- How efficient (Doing things right) are the technologies (considered as means) in achieving the curricular goals?
- How effective (Doing the right things) are the technologies in achieving specified objectives?
- How good is curriculum, a unit, or a module presented via a given technology?
- Is there a clear congruency among stated goals, actual subject matter content, teaching strategies, and evaluation technologies?

In general, it is to be noted that the technical view does not provide any focus on social and cultural dimensions. It is commonly assumed that technology is *value free and context independent*, and therefore simply transmits existing social/ cultural values without distortion. In this light it is interesting to note that educational technologists often

point with pride to the idea that they are "engineering" instruction. This view implies that what we teach goes through a series of iterations which results only in the best. However, it is useful to recall that engineering in the social sense has connotations of brainwashing, and that the phrase "the engineering of human souls" is attributed to Joseph Stalin.

The practical paradigm, which Aoki refers to as "situational interpretive", focuses on "the meaning structure of intersubjective communication between and among people who dwell within a situation" (Aoki, 1986). This view is the one so aptly characterized by Schwab (1969) within the field of curriculum theory as "the practical." Following a practical model, researchers in educational technology would concentrate their questions situationally in an attempt to gain insights into actual utilization patterns. Practical-paradigm questions might include these:

- How do stakeholders (teachers, parents, administrators, students) view technological interventions?
- What is the degree of acceptance of technological interventions within a specific situation?
- How do concepts of relevance, meaningfulness and appropriateness relate to the technological interventions?
- How do different interest groups perceive the ways technology addresses their needs?

It should be readily apparent that the practical model directly addresses issues of social and cultural relevance. This is achieved within a situational framework. That means, for example, that a technology which has one effect in say, Fargo, North Dakota, will have a different effect

in Winnipeg Manitoba. The over- arching values of Canadian society are not necessarily congruent with the values of American society, yet often our entertainment media are identical. This must however result in, at the very least, different interpretations. Sometimes these will even be in conflict.

A case in point is *Sesame Street.* Indeed, American readers of this paper may not be aware that there is a Canadian version of *Sesame Street* which drops specific United States content, (including all Spanish language sections), and replaces them with Canadian-made vignettes as well as French language segments. Astute viewers living in close proximity to the U.S./Canadian border who receive both American and Canadian versions will readily identify the differences.

Similarly a technological intervention which is appropriate for Canadian white urban students, is probably not identically appropriate for rural native populations. The point is that the practical paradigm focuses on the uniqueness of the specific situation. Within this view technology is not perceived in a negative light, however, neither is technology transparent.

The critical paradigm attempts to capture underlying meaning, free from hidden assumptions. There are two ways of looking at this critical orientation. The first equates "critical" with "critical theory" and gives a Marxist political slant. The alternative uses critical in an artistic/aesthetic sense, as exemplified in Elliot Eisner's concept of curriculum criticism and connoisseurship (Eisner, 1985). At this point of writing, it would appear that the "critical" mode is a grab bag of methodologies including critical theory, connoisseurship, reconceptualism, semiotics, and possibly even postmodernism.

Researchers within this category might frame their inquiry into technology with the following questions:

- What are the underpinning root assumptions being made by the technology?
- How does the technology implicitly shape the roles of the student and the teacher?
- How does the technology implicitly reflect the values of the student and the teacher?
- Whose interests does the technology serve?
- How does the content, the technology and the human being interact to achieve the overall goals of education?

Again, social and cultural concerns are paramount to this view. Within this paradigm, researchers are asking social and cultural questions which have often been forgotten. The most unique aspect of critical methodologies as derived from art criticism is that art allows more than one solution. While the technical model searches for a "best way", and the practical model qualifies that solution within a specific situation, the critical model allows the critic to say "I like it" or contrarily "I don't like it" and to justify his criticisms. This is allowing that individual to be reflective, critical, and emancipated. For example when the popular film reviewers Siskell and Ebert disagree on a film, they do not do so due to lack of formative evaluation, or lack of information. They disagree because they are critics. The role of the critic is to make explicit those assumptions which are hidden and assumed. Meaning is seen to reside within a variety of contexts and criticism makes hidden assumptions visible.

Educational technology is lacking a critical orientation, and requires on-going reflection and discourse so that we may use our technologies to their fullest potential. The social and cultural dimensions are an integral component to this critical orientation.

A postmodern paradigm?

A final view of the technological future in education might be labelled postmodernist. Some dismiss postmodernism as relativism; still others see the postmodern view as nihilistic. In its simplest conception, postmodernism is an acceptance of multiple paradigms and ambiguity. Thus Eagleton writes that "Structuralists [modernists] are convinced that systematic knowledge is possible; poststructuralists [postmodernists] claim to know only the impossibility of that knowledge" (Cherryholmes, p. 32). Atkins suggests that the postmodern vision can be traced to the awareness of the ecological crisis of our planet which "signaled a loss of modern faith in technological progress that was replaced by a postmodern ambivalence (Atkins, p. 131)."

Others would carry the postmodern concept even further, claiming for it a radical vision, which moves significantly beyond an acceptance of multiple paradigms. Thus Lawson (1989) suggests that "while relativism can be described as the view that truth is paradigm-dependent, postmodernism might be described as the view that meaning is undecidable and therefore truth unattainable" (p. xii). However, that does not mean that all is hopeless. Instead the postmodernists try to "paint a picture of freedom from the faith of rationality. Truth is a misleading goal that distracts us from the task at hand" (Lawson, p. xiii).

Educational technology, having grown up in a positivistic milieu, prides itself in its promise of system, of logic,

of precision, of effectiveness and efficiency. Postmodernism questions the very foundation of these values and focuses on discontinuity, on temporal truths, and on complexity. Postmodern thinking results in hybrid rather than pure elements, compromising rather than clean solutions, and ambiguous rather than precise meaning.

As yet, there has been little research in the mode of postmodernists such as Derrida, Foucault or Barthes within the realm of educational technology, although some initial probings have been collected in Hlynka and Belland (1990, In Press).

In the framework of Postmodernism, the educational technology researcher would explore the incongruities of different technologies, different goals, opposing social/cultural needs, and their juxtaposition. Postmodern educational technology would understand the good and the bad, along with the wide range of technological activities. Understanding and accepting roles, practices and meanings, even when they are contradictory. . . perhaps especially when they are contradictory . . .is the essence of postmodernism. On the one hand, it is not an easy road to accept such contradictory statements and values, and allow them to exist side by side. On the other hand, it is the way of the world.

Cherryholmes (1988) attempts to summarize the potential goals of postmodernist explorations in education. These explorations would decenter traditional emphasis on social science concerns and focus instead on the interrelationships among language, meaning, text, and reality:

- Structural criticism illuminates counterstructures that texts and discourses- practices ignore or seek to silence.

- In a Foucauldian genre, criticism produces histories

and politics of the present, wherein texts and discourses-practices are effects of the exercise of power.

- In a Derridian deconstruction, criticism exposes silences and gaps between that which is valued and disvalued, traces the sedimentation of meanings, and documents contradictions and ambiguities within texts and discourses-practices (Cherryholmes, p. 160).

Moore and Garrison (1988) have contributed a provocative postmodern analysis of metaphysical dimensions of educational technology, presented via underdetermined, aesthetic discourse. Their text belongs far more to the minimalist domain of the fine arts, and does not at all meet the demands of traditional positivist commentary. In general, postmodern educational technologists ask questions about the texts which educational technology present, about real and imaginary discourses-practices which reflect technology in education, and about the contradictions, ambiguities and double meanings which the juxtaposition of technology and education present (Hlynka, 1989; 1990). At the moment, this is a road yet to be explored.

Conclusion

Educational technology is here to stay. However, the final judgement as to its impact on the social and cultural dimensions of education for the future is unclear at this point. Servant or master? Boon or bane? Tool or process?

This brief paper has suggested that for technology to have a positive influence on education as we move into the twenty first century, it will be imperative to begin moving beyond a single paradigm of thought, research or practice.

The pro-technologists offer us a view of a bright and exciting future. The anti-technologists show us the dark side

of technological intervention. Naturalistic researchers are showing us how our research can work within a community as a living entity.

Practical knowledge emphases our need to work within a local context. Criticism provides us with an aesthetic perspective. And finally postmodernism allows all of the above views to co-exist in a world in which multiple paradigms are a reality.

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COMPUTERS, EDUCATION, AND ISSUES OF GENDER

Suzanne K. Damarin
The Ohio State University

The presence of sex/gender differences in the attitudes, inclinations, and accomplishments of students using computers in educational settings has been documented frequently in both quantitative and qualitative studies. Generally speaking, females have been found to feel less positive about computers, less sure of their ability to work with computers, and more anxious about computers than their male counterparts (Cambre and Cook, 1985; Smith, 1987). Even when girls and women feel that, as groups, females are as capable as males in relation to the operation and control of computer technology, they tend not to see themselves as equally competent with males; "we can, but I can't" seems to be the attitude of many young women (Collis, 1985). Educators who study attitudes toward computing tend to see the sex differences uncovered as evidence of a need for affective education. That is, the attitudes of females are generally interpreted as indicative of a problem of females and one in need of "fixing" if women are to attain educational equality with males.

However, a different interpretation of the findings of sex differences in attitudes toward computers is possible, especially as the items which typify attitude scales are deliberately broad. Items such as "Computers make me feel uncomfortable" and "I do not enjoy talking with others about computers" might be endorsed for a number of rea-

sons which make very good sense in relation to the lives of women. This is particularly true in educational settings where computers are often most prominent in subjects such as mathematics where females are frequently uncomfortable, or in lessons delivered by CAI which supports the gendering of instruction (Damarin, 1990a). Perhaps computers are more threatening to women as a group than they are to males. Perhaps females, more than male students, are perceptive of the intrusion of computers into their lives. Perhaps females are more resistant to complicity in these threats and intrusions.

Resistance on the part of female students to certain aspects of computer technology has been documented in the work of Sherry Turkle; often this resistance goes hand-in-hand with the tendency to anthropomorphize the computer. For example, Mary, a young adolescent learning to program in Logo, resists top-down structured programming in order to accomodate the perceived personality of her machine (Turkle, 1984, pp. 112-113). Paradoxically, women who learn to program computers tend (more than males), not only to anthropomorphize computers, but also to resist this anthropomorphizing. The female graduate students in Turkle's studies establish personal relations with their computers and then reject those personal relationships, often expressing disbelief at their own tendencies and abilities to establish caring relationships with machine personalities (Turkle and Papert, 1990). Generally, the women in Turkle's studies construct relationships with computers which are more "personal," more complex, and more troublesome than the typical relationship of a tool-user to a tool.

Relationships Between Computers and Persons

Many of the social myths surrounding computers have as their function the preservation of the idea of separateness of persons and machines. School children are taught that computers can do only what they are programmed to do and that the programmer (or user) is not only distinct from the machine, but in control of it. The myth of the household robot, assigned primarily to tasks which are currently performed by women, conveys the idea of a machine which is not only separate from its owner, but totally obedient to him (her?). Moreover, this robot need not be thought of as terribly intelligent in order to do the mundane tasks of cooking, cleaning, ironing, and feeding the dog; the mythical household robot does not pre-empt the rights and responsibilities of male family members. Robots, such as TOPO, which are used in schools for computer programming instruction, like the images of mythical household robots are anthropomorphized as cute, useful, and tractable; created in the image of R2D2, these robots would make nice multi-purpose household or classroom pets.

The myth of computers as friendly, user-friendly, helpful, and obedient, as well as knowledgeable (in some cases omniscient), accurate, speedy, resourceful, and efficient is a part of the basic content of the computer literacy curricula of schools. Moreover, instructional software is advocated and advertized on the basis of similar myths: the computer as teacher is described as patient, even-tempered, and always attentive to the needs of individuals, as well as obedient to the complex hierarchy of instructional objectives. Ironically, the attribution of human characteristics to computers functions to preserve the myth of separateness of computers and persons. Most of the human characteris-

tics attributed to the computer are commonly associated with the female or feminine; computers are not described as macho, aggressive, or virile. In this very real sense the construction of the computer as other to human reflects the construction of female as other to male.

Developments in computer science and robotics, however, run counter to some of the popular myths. Machines which program themselves, and computer programs which perform cognitive tasks well beyond the conceptualization of their creators directly challenge the idea that the machine does nothing but follow rules which are supplied by a human. Moreover, the majority of robots being designed and manufactured today are neither cute nor at the service of individuals. According to robotocists Aleksanderoff and Burnett (1983), robotics is developing in two directions; (1) the development of anthropomorphic machines that are interchangeable with skilled craftsmen (sic), and (2) the reconceptualization of work environments with primary concern for the robotic workers which perform previously human work, but on a different scale or schedule. Together, these developments deny not only the dualistic separation of person as essentially different from machine, but also the notion that individuals are served by the work of machines under their direct control.

The question arises, then, of how humans and programmed and/or programmable machines are (and are to be) related to each other, not only in the perceptions of the users, but also in the minds of machine developers and in the analyses of social scientists. There are currently at least three distinct conceptions which guide "scientific" development of answers to this question (Damarin, 1990b). Some robot scientists and some sociobiologists view the development of the computer as an exo-skeletal stage in the evolution

of "mankind" and foresee the robot as replacing the human being as we know it, perhaps within the next century (Morawec, 1988; Stonier, 1988). In this view, machines endowed with masculine rationality are becoming a superior non-biological form of humanity.

The second view of the human-computer future is that of the cyborg, a single entity incorporating electronic hardware and software into the biological "wetware" of human-type bodies. This conception is consistent with developments in medical as well as computer technologies; it is the vision or view taken in primatologist Donna Haraway's (1985) radical feminist construction of the future and is also the conception which underlies futurist work ranging from the Human Genome Project to current "cyberpunk" science fiction (e.g., Gibson, 1984; Rucker, 1982, 1988).

In the third view, machines retain their mechanical and electronic forms and humans retain their biological identities, but human-computer dyads, or larger groups of humans and computers, become increasingly mutually interdependent for their continued operation. This view (to be examined more fully below) is currently dominant in the conceptualization of computer applications to business and industry and of the uses of computers for purposes of education. Each of these conceptions of the unity of humans and machines has its own conceptual roots, its own implications for the viability or demise of ideas and concepts common to modern thought, and its own relations to feminist and educational thought and to the future lives of all students (Damarin, 1990b). The remainder of this paper examines the third construct, that of the human-machine dyad, from the perspective of a feminist educator.

Women and Machines in Symbiotic Relation

In the vision of the high tech future characterized by person-machine symbiosis, increasingly powerful computers are used by individuals and institutions; in theory, the computer and the computer-user each does "what it does best," as they work together in a powerful dyad. Of the three arrangements outlined above, this is the most commonly implemented in business today, and is prevalent in discussions of the optimal uses of computers in classrooms. This vision is also highly romanticized by those who argue that the computer will liberate workers from dull and mundane tasks and by those educators (the present author sometimes included) who argue that the classroom computer can be used to provide disempowered children with a more liberatory education. These romantic visions are precluded from becoming reality by the unequal access of individuals both to computer power and to power over computer use. Instead, as computers are being used in accordance with this model the power of computers accrues to the politically powerful, and computers multiply social and economic inequity.

The effects of computer implementation in offices, in manufacture, in businesses ranging from McDonalds to brokerage houses, and in social service agencies have been documented by a number of social scientists (Cockburn, 1988; Garson, 1988; Howard, 1985; Zuboff, 1988). In all cases, the functions of the majority of workers are changed to accomodate the efficiency of computer operations; work becomes increasingly fragmented, meaningless, and repetitive, and a large number of jobs, especially women's jobs, become nothing more than the preparation and entry of data for computer manipulation. In the hierarchy of U. S. jobs, black women are found most frequently in the low-

est paid and most tedious jobs for which they are crammed into back rooms where they work with and among outdated VDTs, inappropriate furniture, and poor lighting conditions. Increasingly telecommunication is used to transport data to third world countries for data entry by women paid even less than these U. S. workers. The effects of this practice and of the export of microchip manufacture on Malayan women are graphically described by Aihwa Ong (1987), as follows:

> Electronics technology has exerted control over workers both materially and symbolically. First, the extreme decomposition of tasks requires workers to perform repetitive and minute jobs, Second, management seeks to control the women's self-perception by talking about the "natural" ability of "oriental" women's fingers, eyes, and passivity to withstand this low-skilled, mind-deadening work. The reduction of the social person to an organism subordinated to technological instrumentality is no mere mystification. It constitutes everyday reality for the perception and treatment of workers. ..... gender has been disassembled. (pp. 622-623).

These oriental women, and in this country many black women entering data in office back rooms, are defined as "wetware," biological material essential for the operation of the machines. In some conceptualizations of computers, the fully operational machine consists of hardware, software, wetware, and orgware, the latter being the (technology-based) organizational system which schedules work, monitors progress, and oversees the operation. In this framework, the woman worker is, not complementary to, but an

integral part of the machine.

A similar phenomenon occurs with "higher level" employees in fields such as sales, social service, and consultation of various sorts, who are increasingly "assisted" in their work by computer-based artificially intelligent expert systems. Knowledge which was once a personal asset of the worker is encoded in a data base in the machine. The worker, no longer permitted to speak or act from her or his own expertise (Garson, 1988), becomes an "input/output device" comparable to a printer or other "computer peripheral." The design of the human- machine interface deliberately limits the scope of interaction between the computer and its human user (Fischer and Lemke, 1988). Menu-driven software puts the computer in control of communication, forcing the articulate and imaginative human user to limit communication and restructure inquiry to accomodate the multiple choice directives of the computer. As many jobs which previously required human expertize are limited to serving as a computer interface, these jobs are redefined and made less lucrative. New classifications of employment as "data workers" are identified, and these jobs become feminized, that is, low paid "women's work."

Thus, as the computer-human dyad approach to the workplace integration of humans and computers matures, increasingly women are absorbed into computer systems; race and class distinctions are preserved as women of color and lower class women become wetware while middle class white women become more highly paid computer peripherals. In both cases electronic supervision of workers, increasing pressure for productivity, and poor working conditions prevail. In both cases the women who fill these jobs are reduced to machine components whose claim upon an essential personhood is reduced to their sexuality; that is,

their otherness to the electronic machine lies in their sexual functioning.

Student-Computer Dyads in Education

The use of computers in education, particularly for the education of those students who are not expected to excel in mathematics and science, is increasingly such as to prepare them for the world of the human-computer dyad (see Apple, 1986). The "at-risk" student, very often a person of color, is increasingly provided with (that is, subjected to) "computer-managed-instruction" on so-called "minimal competencies." In these procedures, the computer directs the multiple choice work of the would-be learner as she or he practices the input of responses to questions and problems which have already been solved (or at least could be solved) by the computer itself. Indeed, the decontextualized "minimal competencies" which span the whole of some children's educational experience, have, in a large number of cases, been rendered obsolete in the marketplace; in the workplaces alluded to above, arithmetic, categorization, and the like are no longer "people skills" performed by entry level employees, but computer operations, no longer entrusted to the human worker. Nor are these "skills" the stuff from which an education is made; removed from the contexts which provide them with meaning, the "minimal competencies" can be mastered only (if at all) as facts in themselves to be stored in the human brain against the day when "the batteries wear out" and a human might be called upon to determine some fact or number. For the average citizen, the social utility of these skills decreases daily as the computer-generated and computer-implemented bureaucratic formulae for all facts and statistics become incomprehensible. Numbers increase their power as they sac-

rifice their meaning ... only on minimal competency tests is long division appropriate.

While the "education" of the "at-risk" student uses the power of the computer to direct student practice on decontextualized skills, educational researchers and knowledge engineers are investigating a broad range of issues and techniques related to a variety of ways in which students' learning can be shaped by the computer rather than by experience with material objects, by textual reference to the accumulated wisdom of the past, or by inter-personal communications with teachers and peers. Computer models of systems of thought, language, behavior, and belief are constructed by cognitive and computer scientists, often in the form of expert systems. Such systems "emulate the reasoning and problem solving abilities of human experts" and serve "as powerful tools for the extension and redefinition of human intellectual efforts (Pea, 1987, p. 128)." Through intelligent computer assisted instruction (ICAI) systems, these computer models are used to guide and shape the learning of young students. As Streibel (1986) points out, computer models are restricted to those ways of knowing which admit a procedural representation (that is, a representation in terms of "if ... then" pairs); artistic, methaphorical, historical and other ways of knowing which do not lend themselves to this model are thus eliminated from the base of education, and students are schooled in machine-like thought. Underlying much of this work is the idea of the "co-evolution" of machine and human thought, that is , the notion that education should reflect and support the symbiotic development of "cognitive abilities" of machines and humans. As machines develop new capacities for "cognition" these will drop out of human education and the repertoire of human abilities, thus creating further de-

pendence of the human upon the machine. As the balance of cognitive control shifts from human to machines, the human becomes absorbed into the machine architecture, becoming primarily a source of data for the data-hungry intelligent machine. Thus, at least in some visions, schooling will reduce students to data input and output devices, peripherals to the machine.

Projecting the Future of Student-Computer Dyads

Just as the machine depends upon data from the student, the student comes to depend upon inputs from the machine. In their provocative description of "Kelly's Education," Belland and Taylor (1984) project, in the indefinite future, a world in which Kelly's every cognitive and affective need is met; questions are answered and emotions and attitudes are modified by machine response to the data generated by Kelly through brainwaves and the firing of neurons. It is misleading to say that Kelly is (consciously) communicating with the machine or using it as a tool, for the interface between Kelly and machine is so transparent as to be invisible even (or, perhaps, especially) to Kelly. Moreover, while the process(es) of Kelly's "education" world are described, it is not clear what it might mean to be an "educated person" in Kelly's world. And, then, there is Kelly who is described without reference to sex or gender; according to the authors Kelly might be either male or female (Taylor, 1985) If so, with respect to education, Kelly is neither male nor female, and the education of Kelly's world is unrelated to the social construction of gender. For educational purposes, Kelly and the machine are asexual extensions of each other. If Kelly is other to the machine, this separation is not based upon cognition or mentality. As with the workers in the machine-person

dyads of business and industry, Kelly's sexuality might define her/his otherness to the machine.

If Belland and Taylor share a nightmarish vision of the human-computer dyad in education, other educators claim to have sweet dreams of the human-computer future. J. Aaron Hoko (1989), for example, asks us to:

> Imagine a small boy lying in bed with fists in eyes trying to rub away the last remnants of sleep. From the kitchen he hears his mother's familiar call, "Ryan, Ryyyan! Breakfast will be ready soon. Get dressed quickly." A smile comes across the child's face as he crawls out of bed and makes his way to a desk in the far corner of the room. As he sits down a slightly older feminine voice reminds him, "Ryan, it's breakfast time." Rising from his chair the boy responds, "OK Sis, I'm hurrying. Quickly the boy dresses. (p. 136).

Sis or SIS stands for "Smart Instructional Systems" and, as Hoko continues his story, SIS is with Ryan throughout the day, both at home and at school. SIS is (or simulates behavior which is) kind, patient, and nurturing of Ryan as it leads him through his arithmetic and his wordlists, provides graphic and game "rewards" for work well done, schedules and monitors his reading group, and so on. Although Hoko's paper title claims that SIS provides a way in which computers enhance teacher's pedagogical power, the only function of the morning and afternoon proctors (who are, presumably, the teachers in Ryan's classroom) is to make announcements. As Ryan ends his day SIS tells him a dinosaur story, and

> As the story is being told, Ryan's father slowly and quietly enters the small boy's room. Ryan,

> sitting at his desk, hardly notices that his father is now standing behind him. The father listens and looks thankfully toward the animated desk surface. Fingers of his left hand gently massage the boy's small neck; fingers of his right hand gently caress the inscription on the corner of the desktop. It reads "Smart Instructional System (SIS)." (p. 138).

The vision of SIS and its environment is an eerie mix of doctrinaire behaviorism, post-modern technology and pre-feminist mentality. Manipulating data gathered by scanning Ryan's retina, by monitoring events in his home and classroom, and by consulting the built-in course of very traditional school study, SIS is clearly the salient actor in Ryan's life. With its "slightly older feminine voice" and more patient (big SISterly) messages, SIS displaces Ryan's mother, as well as his teacher, as guide and authority. Moreover, it is SIS, and not Ryan's mother, which receives the thankful look and the gentle caress from Ryan's father as the story ends with SIS receiving the seal of masculine approval. In short, in the vision of Ryan and SIS the human-computer dyad is composed of a young (white?) male human and a machine which has usurped the traditionally feminine virtues and privileges. Simulating, and thus essentially replacing the female, SIS creates an environment which is a nostalgic simulacrum of the mythical life of the white middle class nuclear family of the 1950's. In Hoko's copy of the nuclear family, however, the traditional mother has been disassmbled, divided into two; the computer serves as nurturer, while the female is present, presumably as an agent of biological reproduction, and more pointedly, as a nagging scold who should be ignored.

In the human-computer dyads of the workplace and those of which Kelly and Ryan are parts, the computer exercizes direct control of the human. Kelly is totally controlled and without choice, indeed without knowledge, as to the direction of her/his behavior. It is unclear whether Ryan can resist the directives of SIS; in Hoko's portrayal he doesn't choose to defy SIS in any way. The computers in each of these myths have clearly been programmed in accordance with a theory of learning (neuropsychology for Kelly and behaviorism for Ryan), a theory (unarticulated) of the purpose of education, and a theory of instructional design. The question arises, then, as to whether it is these theories that are responsible for the horrors of these visions, or whether the very idea of a human-computer dyad leads inescapably to such visions.

It has been argued that one purpose for having students learn to program computers is that students learn that they control the machine, and not vice versa. None-theless, student programmers are not unaffected by their computer use. Adolescents observed and interviewed by Turkle (1984) use their experiences with computer programming to construct new ways of thinking about themselves and of modifying their own behavior. About one troubled young woman Turkle writes:

> Before she met the computer Deborah didn't think about her problems in terms of control. ... She needed a world apart in which to build a new set of distinctions that she could then transfer to her way of thinking about herself and others. The computer provided this world. It gave her categories more useful than good or bad: things could be in or out of control. With the new distinction

> came a new way to think about her problems: I am in trouble because I have no rules. I am not in control. And I should be. I can be (pp. 144-145).

Other students whom Turkle interviewed spoke of "debugging" their own thinking and behavior. From their work with computers these students have learned to analyze themselves and to think of themselves as programmed, perhaps just as programmed as Ryan and Kelly. Hierarchy, control, and bug-free rules determine (or should determine) their behavior. This is a different view of behavior than that provided by Skinnerian conditioning theories and, indeed, Turkle (1988) argues that the existence of the computer relegitimates the idea of memory and is, thus, responsible for the demise of behaviorism. However, the construction of behavior as determined by rules and principles, hierarchy, and control is no less focussed on the values which characterize patriarchal systems.

The Non-Neutrality of the Human-Computer Dyad

Thus, the human-computer dyad takes many forms in educational settings, both real and projected. In each of these forms, the behavior of the human is constrained by or constructed in relation to the operations of the computer. In turn, these operations are derived, in part, from the designers sense of what are important features and variables. Sex/gender of students does not seem to be included among the variables which are theorized; instead the common tacit assumption is made that the male student is representative of all students.

With these observations, we return to the issue with which this paper began, female student's attitudes toward computers. The business and educational uses of computers cited in this paper and its sources are clearly gendered.

They constitute sufficient reason for females to be wary of computers and resistant to them. Female wariness and resistance, however, contribute to the continued domination of the computer field by males who (naturally or necessarily) construct computer applications from a male perspective. As computers become more multi-faceted and powerful, so too does the influence of the male perspective. This influence is nowhere more apparent than in the design of artificially intelligent approaches to education.

Extending her analysis of computers, Turkle (1988) asks us to consider artificial intelligence as a "sustaining myth" which is comparable to psychoanalysis in its discursive power:

> We are afraid of the sexual and aggressive sides of our natures, but we want to be in touch with them as well. Psychoanalytic ideas give us a way to play with what is forbidden. Similarly, we are afraid to think of ourselves as machines, yet we want to find a way to acknowledge this very real, if disturbing part of our experience. Playing with AI, with the idea of the mind as computer, makes this possible (p. 266).

With this sugggestion, Turkle asks us, not only accept as analogous the constructions of ourselves as sexual and as mechanistic, but just as importantly to reverse the direction of the original metaphor linking human and computer intelligence. No longer should we view our human selves as the primary agency by reference to which we construct, understand, and interpret the actions of "intelligent " machines. Instead we should view the man-made machine as the principal and principles through which we construct, understand, and interpret ourselves. These are indeed provocative demands.

Turkle's analogy highlights the common roots of psychoanalysis and artificial intelligence in patriarchal world views and masculine notions of the normal and normative. The response to psychoanalysis of females in general and feminists in particular has been varied, ranging from total rejection to appropriation and revision of its theories (Ramazanoglu, 1989). The mixed and negative attitudes of females to computers may reflect the beginnings of a comparable ambivalence. It is my fond hope that this ambivalence will lead, not to new and more effective programs of affective education, but rather to a rethinking and reconstruction of human-computer relations, especially in educational settings.

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MEDIA EDUCATION AS CRITICAL PEDAGOGY

Robert Muffoletto
University of Northern Iowa

Over the last ninety years American schools have had to meet the expectations and interest of various social, economic and political communities.[1]The pressures brought to bear on American schooling originated in business and special interest groups (religious, ethnic, racial and gender), and shifted from a rural agricultural ideology to an urban technobureaucratic ideology (Larson, 1977). How these interests and shifts were played out and legitimized in teacher education, curriculum development, classroom practices, and in the management of schooling were in part controlled through federal, state, and local funding and an increasing reliance upon principles grounded in psychology, empiricism, scientific management techniques, and the professionalization of education (Popkewitz, 1986; Larson, 1977).

From the late 1930's to the present education has witnessed the melding of learning theories, based upon behaviorism and cognitive psychology, with various media delivery "systems" or educational technologies. This melding of theory and practice changed the role and perception of the machine from an audio-visual "aid" to a pre-packaged system for the management and delivery of instruction. Considering the growth of a hierachial professionalism in education and the notion of the distant and detached expert, instruction and knowledge is now perceived by many to reside within the teaching machine itself (Larson, 1977). The

site of expertise has shifted from inside the classroom to one outside the classroom, accessed only through the machine. The positioning of the machine as deliverer of instruction places the device within a technoscience as well as epistemological paradigm. Embedded within the language of individualism and knowledge, the teaching machine comfortably fit into the liberal ideology of the nineteenth and twentieth centuries. With a shift in location of expertise, the teacher was further removed from the conception, planning and production process and was placed in the role of manager of instructional materials (Apple, 1988). Couched in the ideology of capitalism (that emerged out of the scientific management of labor movement of the nineteenth and twentieth centuries) the educational work place had to be efficient, effective and accountable to the eyes of those who saw their future interest dependent upon what schools did and did not do (Callahan, 1962). The emerging new technologies as a technobureaucratic system sought to control the variables that led to the perceived problems that plagued our educational system: inefficiency, ineffectiveness, lack of accountability and standardization (Larson, 1977; Rossi, 1966; Popkewitz, 1986). Central in this debate was (and is) the classroom teacher.

Viewing the teacher as part of the problem to the production of worthwhile products (students), educational technology appeared to offer a solution to a problem defined by those outside education (Heinich, 1985). Through a systematic identification of needs, the development of instructional materials and packages, and evaluation of instruction, educational engineers could offer instructional packages that were free of teacher intervention, biases, and knowledge deficiencies about content, teaching and learning (Heiniech, 1985; Cuban, 1985). The development of

this systematic technobureaucratic based approach to education was further enhanced and encouraged with the development in the 1970's and 80's of powerful desktop computer systems, telecommunications, distant learning technologies and expert systems. It is now technologically and ideologically possible for curricular materials to be delivered to students in and outside the classroom without the intervention of on-site classroom teachers. With curricular, strategic and production decisions for the packaging of educational software occurring outside the classroom by experts (decisions occuring at two levels; the corporate level where profit is a deciding factor and the institutional legitimizing ideological level where the visions and justifications are grounded and legitimized), teachers are further removed from the conceptual and production process (Apple, 1988; Muffoletto, 1984). This shift in the locale of conception and production demands less of the epistemological, organizational and creative skills previously required by teachers when she or he controlled a larger portion of the educational experience. Not only did this change affect the skills required by the teaching profession, it affected the vision and status of teachers as professionals (Larson, 1977; Popkewitz, 1986; Apple 1979, 1988).

A distinction must be noted between technology perceived as a tool encompassing hardware and software, and technology as a systematic technobureaucratic form that embraces positivism and management ideologies. There is an important difference between teachers using, and sometimes being overtly or covertly required to use, curricular packages that originated outside their classroom and school, and their idiosyncratic use of various applications and individual programs to meet "their" perceived needs as educators and the defined needs of their students. How

those needs are arrived at and defined emerges out of a technosystematic ideology of schooling (Apple, 1979). Technology perceived as a tool, or technology perceived as an "expert" teaching machine/system means different "ways of thinking", setting different horizons for and about teaching. Taking one position over the other raises complex issues concerning the relationship of schooling and teaching to the ideologies of the state and capitalism. In short it determines actions of teachers in and outside the classroom, as well as how they "think" about what they do and don't do.

Within this ideological construction, it is important to locate the effect of current reform movements suggesting a one year teacher training program on the deskilling and reskilling of classroom teachers (Muffoletto, 1988). If the reform movements are viewed within the horizons of an extensive concern for testing at the state and national levels, various national committee reports, mass mediated texts (primarily in the form of films and television specials where educational problems and solutions are offered by the networks), the social and economic status of teachers, and the increasing capabilities of technology to store, retrieve and deliver information and reality, a one year (which is usually refered to as a five year program) teacher education/training program not only devalues education as a discipline but tends to reify the current professional status of teachers in relationship to management and knowledge experts- the technobureaucratic ideology (Berger, Berger Kellner, 1973). By reducing a multi-year involvement in teacher education to a one year teacher training program, pre-service teachers are not provided with the reflective critical tools and frameworks through which to consider their actions and the actions of others. (I point out that a

four year program in teacher education that does not take a reflective position towards knowledge and power will in the end be no different than the one year program.) If pre-service teachers are not equipped to perceive schooling, curriculum, and the evaluation of their work as social, political, and economic constructions they will consider them as being naturalized and correct. As constructed subjects teachers will not have the conceptual infrastructure or the analytical skills to critically reflect on the nature of their workplace or curricular materials they may be required to use.

Textbooks offer us a case to consider. Teachers are rarely given the conceptual skills to deconstruct the political, economic and social agendas found within the covers of textbooks. Teachers are usually directed to follow the content and sequence of the text. Since textbook publishers attempt to align their texts to state frameworks, there is a correlation between state mandates (usually controlled through various forms of testing) and the scope and sequence of approved textbooks. The system is then in place. If teachers follow the text and its accompanying materials, they are following the state framework. In this manner the text begins to drive the curriculum (Apple, 1979, 1988). In the end, if teacher education programs do not empower teachers to make informed decisions on the use and evaluation of curricular packages they will truly become the "managers" of instruction and not it's creators (Muffoletto, 1984, 1988). In time, through the socialization and reproductive process of teacher education, the relationship between teachers and packaged curricular materials will be normative. Experts in both the content and delivery of knowledge will reside elsewhere. As constructed subjects, the image of the teacher as a manager and facilitator will

be cemented. Through this normalization process teachers will then assume the same professional (or lack of) status as the assembly line worker; a replaceable part in the production process (Larson, 1977). Instruction will be conceived, standardized, evaluated, and packaged outside the classroom by others (Apple, 1988).

The positioning of teachers as standardized replaceable parts has important implications for the decision making process at site and district levels, as well as at centers for teacher education. As education becomes more mechanized and controlled by those outside the classroom, the status and professional positioning of teachers will be further reduced. As teachers are socialized within technobureaucratic working environments their skills in production and creation will be devalued and dismissed. How teachers think about themselves as professionals and as educators will be affected by the type and perceived value of the work they perform. As noted by one writer, "The mechanization of production robbed the working class of its last hold on the means of production–its crafts and its skills." (Larson, 1977, p. 238) Locating conceptual activities and the means of knowledge production outside the classroom, paralleling the repositioning of the teacher as a manager of instruction will further, within a bureaucratic ideological framework, act to redefine the skills of teaching and our conception of it. Except for marginal sites of resistance, education will go the way of other crafts and arts. The subjectivities of teachers will be constructed to fit the dominating ideology of science, mechanization and bureaucracy. What is at stake here is the subjectivities of teachers. As constituted historical subjects, teachers will assume the power and epistemological relationships of education and the dominant culture/ideology to be normal and correct.

As Larson (1977) suggests, "The ideology of the rising or ruling class is dominant precisely because it is shared by the dominated." (p.239) If teachers are not provided with the tools to deconstruct and reconstruct the logic of their own work place they will not have the skills needed to critically analyze education nor themselves as historical subjects. They will share and support the dominant ideology which positions them within a historical social political arena. They will assume that the way teaching is packaged in teacher education and lived out in the classroom is the correct and normal way. The emblematic textbook will drive the curriculum, as an institutional ideological text it will drive the teacher/worker.

It is my position in this essay that media education has the potential to provide analytical tools and "ways of thinking" that can be transferred and applied to other pedagogic activities. This framework can provide teachers with a perspective to understand and possibly to re-create their situation.[2]Media education in this frame of reference is not simply the training of teachers to use various hardware (computers, film projectors, cameras, etc) or software. Nor is it a pedagogy that provides a check list for media selection and application. Media education (being different from educational media) requires the teacher to consider all media texts as constructed historical objects, as intended messages existing within a pre-established signifying system (Masterman, 1985). A media education curriculum considers the construction/production of texts (the making of the intended message), the various forms texts take (television, print, film, computer software, objects, an interactive environment), and the reproduction or reconstruction of meanings by receivers/learners (Fish, 1980). It is important to note that these "texts" exist within a subjective

world and were created to benefit and endorse a specific point of view through previously legitimized constructs of knowledge and ways of thinking. The correspondence between text and reality, text and fact, text and truth, has historically supported the notion that the text was a window upon the world.

To be able to break from this dominant ideological position it is important to position media texts (print, visual, or aural) as ideologically, historically and contextually built windows upon the world. Portals that provide points of view which do not depict or represent the natural. Media texts are historical social constructions which reflect ideological positions. As one writer suggests, it is important:

> to see the media as symbolic systems or signifying practices which deal in representations rather than reflections of reality, is to understand the necessity for 'reading' the media rather than passively accepting them as substitutes for experience. It is to recognize . . .that the ideological power of the media resides in their plausibility, in the ability of the media owners, controllers, and workers to pass off as 'real' or 'natural' what are inevitably partial and selective constructions of the world. (Masterman, 1986, p.38)

How the world comes to be known to us is no simple matter. Educational media draws its strength from its iconic and denotative relationship to the real world and to other mediated experiences. Students and teachers (as well as the rest of us) only know of the "real" world outside their immediate environment through mediated texts that encompass previous experiences, expectations and futures (Arnhein, 1969). Meaningful knowledge of our own immediate

environment has been constructed and limited through language as a subjective and constituting process of socialization and enculturation. One of the first steps necessary in teacher education-media education is to situate our understanding of the world as a collection of organized mediated experiences. Curriculum as the selection and organization of knowledge and experiences, and media as a form for the packaging and distribution of that knowledge, must be explored from critical perspectives that address concerns of power, control, and benefit.

If education is seen from a perspective of a communication model, one side telling the other, then teachers and students must address the idea that "communication forms are not 'innocent' and transparent carriers of meaning. They are impregnated with values and actively shape the messages they communicate." (Masterman, 1985, p.27) For teachers to function beyond being passive receivers and managers of curricular materials educational texts should be approached as messages constructed by a sender/producer for an intended audience (teachers and students). Since texts are produced with the purpose of communicating intents, a critical approach for looking at curriculum would inquire into whose meanings are being presented, and what are the implications for thought and action if those mediated experiences are accepted as real by an uninformed or non-critical audience. (Freire, 1985) This is especially relevant if that audience is the future disseminators and evaluators of formal knowledge (school knowledge).

To this point, two major ideas have been stressed. First, teachers are being separated from the skills and knowledges that have taken time for the profession to develop. In place of those skills and knowledges are curriculum packages that

are conceptualized outside the classroom by others. Second, educational media is a constructed message that when unraveled reveals its true nature, one that is political and serves the needs of its producers.

Media education within a teacher education program goes beyond teaching analytical skills for the deconstruction of media messages. Its real purpose is a liberating one—liberating teachers and students. If Ann DeVaney Becker, Michael Apple and others are correct, that schools serve to reproduce the consciousness of the dominant culture (Apple, 1979; Freire, 1985; Atkinson, 1985) and that educational media are signifying systems that re-present "a" world view (Becker, 1983; Muffoletto, 1984, 1987; Masterman, 1986), the question of control and benefit arises. If the dominant culture controls the production of media messages intended for schools, and if they also control the state and economic apparatus (Therborn, 1980) which mandates what is viewed as acceptable and legitimate performance by teachers and students (regulations for credentials, end of year student testing, teacher exams, and other forms of accountability measurements), then its more than a question of who controls the institution. It becomes the question of who controls the minds of the controlled (Schiller, 1973). Media carries messages that move beyond the notion of naturalized text, showing the world as it really is (or as we wish to show it to you). It is a determinate factor in how we "think" about and locate ourselves as subjects within a mediated socially constructed world.

Educational media, like commercial media, constructs it's viewers/receivers as subjects within a perceived finite universe. Freire (1985) sees it as a prescription for standardization of thought:

> In mass society, ways of thinking become as standardized as ways of dressing and tastes of food. Men begin thinking and acting according to the prescriptions they receive daily from the communications media rather than in response to their dialectical relationships with the world. (Freire, 1985,p.89)

Ways of thinking, standardized or not, are ideological. Ideology "unceasingly constitutes and reconstitutes who we are" (Therborn, 1980, p.78). Media messages not only constitute what is knowable, but in a very significant way, who we are.

Media texts not only define and package what is important to know, and how we should know it, they also are part of that environment which strives to define the teacher as subject. Who the teacher understands themselves to be is an ideological process. Seen in relationship to self-contained media packages (CAI, ITV, ETV, Kits, etc.) or to analytical perspectives, the teacher's identity is interwoven with the material of their labor. What is at stake here is the very nature of teaching and learning and the lives of those who teach and learn.

What then is the role of media education within a teacher education program? As mentioned earlier, media education is not a check list of skills to acquire or attitudes to develop. Media education demands that the individual take a reflective and analytical position, one that is political and personal. It requires the individual to actively participate in the unfolding of events. Media education, used in its broadest definition, addresses schools, curriculums, instructional materials and packages, as well as teachers and students, as constructed signifying systems.

Even though the media education curriculum may directly concern itself with the deconstruction of media production, programs/texts and receiver responses, the essence of the critical pedagogy offered through the reconstructing of media texts, relates to and is transferable to all curricular areas. Media education offers to teacher education "a" entry into a critical dialog as to the meaning of things and their impact and implications for teachers and students.

If a critical pedagogy, built upon the concerns of a critical media education curriculum, were offered in teacher education programs, pre-service and inservice educators may come to hold a different epistemological and political position in relationship to their everyday practices, the materials and instructional packages that enter their classroom, as well as their own education/construction as teachers/subjects.

Teachers within this critical arena may not accept the status-quo naturalized version of teaching and learning, but would see it's dialectics and contradictions, its uses and abuses. Teacher education would be "a process by which the teacher educator invites learners to recognize and unveil reality critically" (Freire, 1985, p.102).

Endnotes

1. The connection between the needs of industry and education, between established world views and the views of others, and education's position as a social gatekeeper, become visible when the status quo become threatened.

2. As teacher education shifts the experiences and concepts provided in preservice programs form the world views or horizons of new teachers. They tend to think of the way things are, are the way they should be. It can be no different. This has an effect on how teachers understand the world of possibilities and their position in it.

3. There are individuals and groups who are striving to produce curricular materials that in themselves are critical and offer an alternative to the

naturalized package. But in most cases, instructional designers, curriculum developers and content experts see their role as providers of a curricular form that can not be interrupted. The system is in control.

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THE QUESTION OF RESPONSIBILITY IN THE CONTEXT OF INSTRUCTIONAL TECHNOLOGY

William Taylor
The Ohio State University
Eva Konstantellou
The Ohio State University

Instruction is not a naturally occurring phenomenon in the physical world; not something that has always been "out there" waiting for an auspicious moment of discovery. Rather, instruction is a human creation and the addition of technology to instruction is also a human activity. Instruction and instructional technology are human inventions that spring from human values and human designs. They are value saturated and operate in the social world quite unlike phenomena in the physical world such as tadpoles or star clusters whose existence and behavior we typically do not attribute to their internal value preferences. Social inventions such as instruction and instructional technology, both in their inception and subsequent histories, are never value-free or value-neutral. They resonate with the values of their human creators who themselves are situated in a particular culture in a specific time and place. As the culture evolves, old social inventions may be seen as having fortuitous carry over qualities or, at the other end of the continuum, they may be seen as deeply flawed for this time and place. But we can only know this or hope to act on this knowledge if we engage in social interpretation and articulate a sense of responsibility for open-ended criticism

within education of the rationales offered with our inventiveness.

People everywhere are coming to realize that we can ill afford to suspend judgement on our human inventions and technologies. For we have done so in the past at a mounting cost to the delicate fabric that sustains our physical and social existence. We continue to read George Orwell's *1984* because it vividly reminds us that technology can be used to eliminate all human freedom, even the freedom to think private thoughts. A recent survey conducted by the U.S. Office of Technology found that 42 percent of the public believes technological development must be restrained to "protect the overall safety of our society" (Grossman, 1990, p. 44). We are coming to realize that the unforeseen side effects of our technologies turn out in the long run to be more important than the presumed advantages that were hoped for at the time the technology was originally invented and installed. It can be argued that nuclear fallout from Chernobyl is more important than the electricity the plant generated. Toxic groundwater has greater consequences for us than the original boost to farm yields that resulted from the uses of herbicides and pesticides. The destruction of the ozone layer will hurt us more than a pesky underarm order. The unintended impact of a technology is part of the reality of technological development regardless of the setting into which the technology is introduces. This paper explores an unforeseen side effect of technology and, specific to the application of instructional technology begins to pose the question if we might not be giving up more than we have gained.

The development of instructional technology over the last quarter century can be viewed as a continuation but also a transformation of the three hundred year rise of in-

struction in the West. Instructional technologists, by this we mean all educators interested in instructional systems, have forced to the fore a number of questions present but historically left indeterminate in the growth of instruction. One question, and the one we are concerned with here, is the question of responsibility: Who is responsible for a person's education? Instructional technologists depart from traditional views of responsibility in instruction by addressing the question in the following way: they assume singular responsibility for delivering tightly structured programs that theoretically compel student achievement. Consequently, over the past twenty-five years responsibility for education has moved away from an indefinite concept shared within a community web to an exact, particularized notion of an individuated possession. Further, instructional technologists claim this possession for themselves, removing the possibility of exercising responsibility from the student–or any other agent in the community.

This current status of responsibility within instruction is troubling to many, even to a few of us who have observed these changes from within the instructional technology field. Admittedly, posing questions about responsibility is a complex task with implications that extend to the limits of the culture. This chapter attempts to examine the notion of responsibility in light of how that concept has been shaped in recent decades in the tradition of instruction. As we talk about responsibility we will have in mind a definition of that concept that presumes that humans have the potential to act as free moral agents in choosing their acts in light of the consequences–choices that are guided by deliberation and internal sanctions (Craig, 1982).

What would happen if students were asked whether they thought they were responsible for their education, or they

thought education was something that happens to them? Or, to put the question another way: Do they think education is something they do or something that is done to them? Studies conducted by Swedish psychologist Ference Marton help us speculate about how this question might be answered by students. During the 1970s Marton sought to look at the different ways students experience the notion of responsibility within the learning process. Early in his work he began to identify at least two different orientations to that process.

Marton found that the college students he studied differed in the way they approached academic work. One group defined the content of academic work in terms that connected that work to their lives and world. The second group spoke of academic work in terms of the books that constituted the literature for a specific course, almost as if each course was inclusive and self-referential. "In the first case," Marton says, "they seemed to experience knowledge as a part of themselves or as a change in the way of conceptualizing certain phenomena in the world around them. In the latter case, academic knowledge was experienced as something external, something that existed independent of the person." For Marton, "These two attitudes appeared to be connected with two different conceptions of learning: learning as being something you *do* and learning as being something that *happens* to you" (Marton, 1979, p. 604). Marton senses that this latter group is growing in number.

Continually, when working with our own undergraduate students we encounter this latter attitude–that learning is something that happens to someone. For example, we sense that many, if not most, of our students feel that we are primarily responsible for their education. They come to class with the expectation that we will provide explication of

the course in terms of a list of objectives. These objectives should communicate, as precisely as possible, the exact content of the hours they will spend in class throughout the term. Commonly the objectives represent an organized checklist of skill-based, convergent outcomes. A syllabus becomes the packaging, so to speak, for a product that we are responsible for delivering. Through the syllabus they will understand what is expected of them. That is, the total realm of expectations they have for themselves rest on the clarification of that checklist of objectives. Typically, such a checklist is a superficial expression of educational possibilities. Often, our efforts to diverge from that checklist and challenge them to think for themselves, ponder, exercise their curiosity, to encourage them to stretch themselves beyond the explicit structure of the course, are met with surprise or even resentment. Evidently, once they have the course in hand, as elaborated in the form of the syllabus–this external, decontextualized document–any hint that they might create internally an extension of the stated curriculum presents an expectation for which they believe they are not responsible.

The notion of responsibility in education and instruction in our society has traditionally been left relatively unsettled. Other societies have been more definite. For instance, the God of Deuteronomy held all Israel's adults responsible for the child's knowledge of God's law. Moses admonished his people that, ". . . these words, which I command thee this day, shall be in thine heart: and thou shalt teach them diligently unto thy children" (Deuteronomy, 6:6 & 7). Failure to do so, Moses warned in graphic terms, meant the destruction of Israel.

To quote a modern example of a very specific sense of responsibility, George De Vos, a Berkeley anthropologist,

says, "The Japanese mother is a very important influence on the education of her children–she takes it upon herself to be the responsible agent, reinforcing the educational process instituted in the schools" (personal communication, April 1987).

In our culture, various notions of responsibility as it relates to education have lived side-by-side. Ours has been a pluralistic concept, at times emphasizing the role of the community, at other times singling out parents or teachers or children for special treatment. For example, in decades past it was not uncommon to hear a statement such as "education is self-achieved": a statement establishing student responsibility. Other views make responsibility external to the student and leave the primary locus with another agent, for example, the teacher. Today, in our view, educational responsibility has been externalized to the point where it no longer resides in traditional agents but in a newcomer on the educational scene: the Instructional Technologist with his or her systematically designed courseware.

To understand the externalization of responsibility as influenced by Instructional Technology we need to look for a moment at the historical conceptions of a particularized mode of teaching called instruction. The modern notion of instruction in the West is an invention, so to speak, of the seventeenth century. In its historical sense, modern instruction began to shift responsibility for education from the student to the teacher. Modern instruction assumes: I, as the teacher, have the critical knowledge you need and I will give it to you. Instruction means, therefore, that through its directing power, students would converge upon the teacher's truth.

This notion of receiving instruction as the legitimate method for becoming educated was first put forward in the

mid 1600s by Johann Comenius. Prior to the advent of instruction students engaged in study. Education was seen as a student responsibility. Education was a process of self formation–a personal transformation. One studied, one remade himself or herself for the glory of God. The function of teaching was primarily hortatory for the purpose of encouraging study. In addition, teachers provided instruction on the heuristics of study. But no one dreamed that a student could be instructed into an educated person for that involved personal self formation. But Comenius, who incidentally turned down the presidency of Harvard in 1640, struggled to articulate a sharp departure from the traditional conception of study. His idea of instruction is best expressed by the title of his book on the subject:

> The Great Didactic Setting Forth the Whole Art of Teaching All Things to All Men or A Certain Inducement to Found Such Schools in All the Parishes, Town, and Villages of Every Christian Kingdom, that the Entire Youth of Both Sexes, None Being Excepted, Shall Quickly, Pleasantly, and Thoroughly Become Learned in the Sciences, Pure in Morals, Trained in Piety, and in this Manner Instructed in All Things Necessary for the Present and the Future Life (Keatings, 1896).

In the title of his text Comenius claims in effect that he is privy to a specialized knowledge, an expert knowledge that can guide his students into the next life. Comenius claims to have knowledge that others do not. Correct knowledge is scarce knowledge. Scholars, such as Robert McClintock (1971) and Ivan Illich have noted that instruction–the idea that I have it and I have all that you need and I will transfer it to you–has the effect of denying the possibility of

student creativity and curiosity. As Illich asserts, "In both traditional and modern societies . . . instruction deadened self-confident curiosity" (Illich, 1978, p. 71).

The rise of instruction since Comenius has not been a steady uphill climb. Instruction, in its modern construction, has been subject to a number of detours and elaborations. However, the value base that ultimately supports the notion of instruction–the mechanism of transfer and convergence–can be traced, in our culture, as a straight uphill climb.

In the three hundred years following Comenius, his central conception of instruction gradually spread throughout Europe and North America. In the mid-twentieth century instruction entered an era of rapid expansion by virtually colonizing all expressions of study. In the 1950s, Ralph Tyler fitted instruction to a technical model. By preestablishing objectives and determining the achievement of those objectives through evaluation procedures Tyler provided instruction with a mechanistic teleology: each classroom activity has measurable purpose. His basic formulation of the constitutive acts of instruction has not changed since. Tyler's technical rationality was augmented a few years later by B. F. Skinner and the Instructional Technology movement. Tyler's operationalized model of instruction laid the groundwork for what Skinner and instructional technologists were to call a *science of learning* and a *technology of instruction.*

Instructional Technology, in a sense, was launched with Sputnik. Within months of the satellite, B. F. Skinner (1958) had published in the journal, *Science*, his now famous essay on teaching machines. From a soon to be celebrated lab off Harvard Yard, Professor Skinner offered up his prototype machine–an apparatus to implement the pro-

gramming of instruction–and promised to set it down in every classroom in the land. The assumption was that educators were on the verge of a true science and technology of instruction.

Instructional technology integrates the determination of curriculum, as well as its delivery, within one interdependent and convergent instructional system. The instructional technologists' assumption is that the infinitely patient technology allows the students to go through the program at their own pace and as many times as necessary to achieve the mastery level pre-specified in the courseware. Recall that instruction began the shift of responsibility away from the student to the teacher. The new formulation presented by instructional technology shifts the locus of responsibility further away from the student. This time the shift is not to the teacher but to the instructional technologist. To understand this move it is useful to introduce the notion of the Carnegie Unit.

In 1905, Andrew Carnegie provided ten million dollars to establish the Carnegie Endowment for the Advancement of Teaching. Carnegie meant the endowment to be a pension fund for college professors; what eventually became known as the Teachers Insurance and Annuity Association (TIAA). Carnegie established a board to run the endowment made up of college presidents and bankers. The board immediately found there was no agreement as to what defined a college professor because there was no agreed upon definition of what constituted a college in this country. By 1909 the board defined a college as an institution that matriculated students from a particular kind of high school which the board members also defined. Their definition was based on the establishment of a unit of academic work based on time (The Carnegie Foundation for the Advance-

ment of Teaching, 1909). In short, a student earned one unit of high school credit in a subject in a class that met five times a week for one school year. The Carnegie board decreed that an official high school was a place that provided its students with fourteen Carnegie units spread over four years. An official college was a place with at least six professors and a four year program providing a specified number of Carnegie units. An official professor eligible for Carnegie's benefaction was one who retired from an official college (Tompkins & Gaumnitz, 1954).

In retrospect Carnegie's ten million dollars not only provided the beginning of a retirement fund for college professors but much more importantly, the Carnegie board consciously defined and standardized the high schools and colleges of this country both in their structure and their curriculum. "The Carnegie unit became a convenient mechanized way to measure academic progress throughout the country" (Boyer, 1987).

The precise definition of what constituted a Carnegie unit has been enlarged and redefined several times since its establishment. The unit that came to measure academic progress at the collegiate level eventually incorporated several elements. Fifteen hours of student contact spread over fifteen weeks with a qualified professor remained the basic element. What we call today, following the Carnegie unit, one semester credit hour. Other provisions spoke to the currency of the text materials, the breadth of the library, the amount of hours spent studying out of class for each contact hour in class, and so forth.

By the mid 1960s instructional technologists were pointing out that the Carnegie unit was inappropriate to the newly defined realities of instruction. The problem they identified was that the Carnegie unit was concerned with

the resources used for instruction, the input, leaving uncertain the outcome, or output, of instruction, that is, what people learned. Generally, for instructional technologists, the output of instruction, or education for that matter, is equated to measurable learning gains. They argued that the important thing in instruction was not the resources put into it (or the number of hours spent in class) but the yield, that is, the amount learned by the student. Recall that with technologically delivered instruction a student can repeat the program endlessly to meet the prespecified criterion level, or yield. They summed this up, as Robert Heinich explains, by saying under the Carnegie unit time is the constant, learning is the variable. But under the new unit learning is the constant, time is the variable (Heinich & Ebert, 1976).

The technological unit, as we might call it, challenges the notions of instructional time and instructional input, the very core of the Carnegie unit, but it does something more consequential to the concept of responsibility. The Carnegie unit assumes a shared sense of responsibility for the process of becoming educated. A number of people are responsible for providing the resources of education but the students must assume responsibility for transforming those resources and making connections with their lives and world. With the technological unit, instructional technologists define responsibility operationally in the context of a means/ends rationality. The singular responsibility for a student's education becomes identified with the success of the program. The motto that emerged in the early 1960s which expressed this conception of responsibility was: "Students don't fail, programs fail." If, after an appropriate number of attempts through the courseware, the student does not achieve the pre-specified level, the instructional

technologist re-designs the stimulus material. That is, the designers gather responsibility unto themselves for altering the courseware to insure that the student will achieve eventually.

The emphasis on yield and the altered locus of responsibility represented by the systematic programs of instructional technology and embedded in the assumptions of the new technological unit pervaded schooling beyond those programs. These important ideas gave rise to a set of institutions in education including criterion referenced instruction (such as mastery systems) and competency based testing. Another example is seen in teacher accountability systems which are premised on holding the teacher responsible for the yield of instruction. The assumption might be stated this way: Students don't fail, teachers fail.

Who is responsible for a person's education? We implied earlier that the majority of our students seem to think that education is something that happens to them. Considering the history of instruction and particularly the rationales which have driven instructional technology over the past twenty-five years, perhaps the more relevant question is: How could they think otherwise?

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SPECULATIONS ON A CATASTROPHIC FUTURE, EDUCATION AND TECHNOLOGY

Randall G. Nichols
The University of Cincinnati

On Speculating and Predicting

This article speculates about wide-spread catastrophes that are likely to occur in the 1990s and suggests the relationships of those calamities to education and educational technology. The impetus in making these speculations grows partly out of my reaction to many seemingly narrow-minded and naively boastful statements (See Dede, 1990, for instance.) about the wonderfully golden future of education with technology—statements that seem unconscionably ignorant of certain dangerous possibilities in the relationships of Western rational-technical philosophy, education, and educational technology. And when statements of this ilk go so far as to *predict* the goodness of the coming technology, we should be deeply incredulous, for, as implied in the godly quotation above, people who make firm and ardent predictions probably will become unbalanced. Existence will rebuff them. That is why I try to speculate about rather than predict the events and conditions discussed herein.

I have identified each of the events in two simple ways, First, some of them exist now in the consciousness of many people world- wide. Oil availability and biotechnology are topics generally known to many people. Second, my personal history somehow points me in the direction of the

topics. Being a skeptic about technology, I pay attention to electricity shortages, computers in education, biotechnology, and so on.

Beyond mere events, the speculations are about catastrophe. This position is based on two more rational principles as well as on my personal reaction and history.

The first principle says it's a destructive Western belief that humans should or can control most of our existence via increasingly dominant rational and technical descriptions and manipulations (For instance, see Berman, 1981; Bowers, 1987; Habermas, 1984, 1987; Barrett, 1987; Stanley, 1978, on the control issue). Reports of the earth's declining condition make us clearer each day about the predicaments and dangers science and technology (manifestations of rational-technical philosophy) have brought. In contrast, notions of a less rational-technical but balanced co-existence with the rest of the world, wherein our existence is dependent on leaving it free to influence us too, have slipped into a vague background knowledge for most Westerners.

The second principle says that human rational-technical actions have effects that are often increasingly unexpected as well as negative. At any point in time, the latest technical systems may break down less often than earlier ones (they are more efficient). We come to expect and rely on this efficiency. So when things go wrong, we are more surprised and disappointed than we would have been earlier. More "advanced" gizmos are notoriously more expensive, time-consuming, and frustrating to repair. Your new car gets you to more vacations more often, but when the car computer fails, the anger can be immense; you feel have been lied to about the efficiency. You can't fix it yourself and get on to your vacation. More seriously, the car's

development, unexpectedly at first, has caused incredible human death and earthly destruction.

Catastrophic Events

Having made my predilections and principles known, let's move on to the speculations.

- Ecological degradation in this decade will progress to the point of massive deaths and ecological and social disruption. The World Watch Institute reports the growing destruction of the air, the animals, the foliage, and the land (World Watch, 1990). Expect water shortages, water pollution, and air pollution to worsen and begin harming humans on a scale that is irrefutable by techno- philes who see the rational-technical realm as the savior to human problems.

  One of the more frightening prospects associated with this destruction is that eco-degradation, which is encouraged by a very few rational-technical countries and their ages of industrialization and information, will increase exponentially as many peoples around the world buy into the material/natural resources consumption associated with free enterprise–which then ceases to be free.

  Co-incident with the growth of unfree enterprise and eco- degradation, human disease will worsen substantially. For instance, as the oxygen available to us and the rest of life decreases as a result of de-forestation, we will suffer from long episodes of dizziness and nausea, then from permanent memory losses and other brain damage.

- Americans and other Westerners will be immobilized and distressed in the event of either one of the fol-

lowing transportation changes, both of which are connected to crude oil availability. On one hand, there may be sufficient oil and gasoline available to us in the coming decade. So the highway grid-lock that already is increasing will worsen to the point of paralysis. So will sky-lock. On the other hand, it's more likely that oil supplies will fall dramatically short of those to which we are accustomed. This could be because we use up most of the accessible oil (eco-degradation again), but it will occur mostly because of rebellions and political-economic posturing in the oil-producing parts of the world.

In either case, transportation changes will be racking to many aspects of people's lives. Food to feed Britons will be much more expensive or even largely unavailable. In America, the fuel shortage of the 1970s will be paradise compared to the shortage of the 1990s.

- Massive electricity shortages and blackouts encompassing areas the size of countries and larger geopolitical regions will arise. This catastrophe, too, is related to ecological degradation such as using coal, but we'll develop nuclear power before we give up our winter heat. It's more likely that problems with electricity will emanate from two other sources: from inherent electrical system failure, and from rebellions by people in so-called developing nations, people angered by their lack of "power" in the electrical system.

  Electrical systems will reach a point where their scale is large enough to supply all the power we want, but they will fail in unforseen and dangerous ways. All electrical systems fail, usually later rather than sooner, granted, but they fail. The lower third of Manhattan

went black again the other day, even after the massive electrical failure of the 1960s and all the repairs that went into the system. And because we are more and more dependent on electricity, the failures will cause more and more social disorder and deaths than we expect. Doesn't modernity run on electricity? How long can food processing companies and hospitals run on self- generated emergency power?

On the other hand, electricity is manufactured somewhat locally and so may not be as noticeably vulnerable to the kinds of world conflicts already mentioned. But a few people ("have not's") from "developing" cultures are going to change our electricity patterns. That is, some people with the least technical and economic development will get fed up and attack those with more. These uprisings will most likely occur in the Middle Eastern countries, where large populations of economically poor people abutt wealthier Americans, and in Europe, where "advanced" European countries meet the poorest of the old Warsaw Pact countries. There may be no more ironic and elegant way to strike out than to literally pull the plug on those of us with electricity. Compared to overt armed attack, shutting down the electricity to and from a multi-national communications system, for example, would be an easy task, would paralyze a large portion of the West, and would do so without immediately causing deaths. Initially, the West would be more confused and incapacitated than anything else if communications systems go down. And the complexity and pervasiveness of electrical communications systems would militate against their easy repair.

- The information age will create social upheaval. Access to and manipulation of information will increase, but contrary to the propaganda being spewed today (See Sculley's remarks in the preface to Ambron and Hooper, 1988, for example.), there is no reason to believe that the age will be somehow substantially better for most people. The economic and political information that serves to control and organize whole societies will be invented and used by relatively few people, just as it is today. And much of the information (power) will be unavailable to almost everyone. Even today, try to find out exactly how much money democracies spend on weapons. It can't be done because of elitist control but also because of the principle of increased unforseen and negative effects. The computer systems at the Pentagon, Congress, or AT & T are so complex that the information in them is mostly inaccessible even to their own gatekeepers. Further, there's so much information that most of us just ignore most of it–or suffer from useless-info-overload.

  Moreover, as "have-nots" around the world see greater differences in power and poverty, they will rebel. The rebellion will quickly escalate to physical confrontations as those of us with power try to exert greater control and as minorities use the power of their large populations.

- The world's population will continue to grow out of control, and so economic, material, and moral pressures on Western rational- technical nations will reach unprecedented and bursting levels. Is Germany willing to give up most of what it has in order to try to stop the mammoth starvation of millions of peo-

ple? When unavoidable throngs of Mexicans stumble across America's border and die in our streets, will we give away nearly all our material goods?

The levels of irony and contradiction in this population growth are complex. For instance, notice the phrase "out of control." Despite our modern rationality and technology to the contrary, people world-wide can not be convinced to stop having children. Their traditions of baby-making take precedence over all the "progress" we can muster to stop them, even though massive numbers of deaths are associated with population growth. Another level of irony exists in that modern rational thinking and technology that purport to make life better (for instance, through medical technology) also are encouraging unacceptable numbers of deaths—unacceptable because we're led to believe the technology will help us be healthier. So even though lung and stomach cancers are on the decline, death rates in the U.S. from *every* other cancer are rising. Ultimately, medical technology does not work to give us complete and satisfying control over life; it may, in fact, help to create conditions whereby that which we seek to eliminate is encouraged instead. (See Illich, 1976, on this topic.)

- Biotechnology will proliferate rapidly and cause world-wide human consternation that is greater than any ever seen. For instance, scientists already have begun identifying the exact genes that "control" various human qualities; the Human Genome Project will identify and manipulate every human gene. This projection may, in some ways, help us to live better lives. On the other hand, living will be made more difficult.

In a biotechnological future, the desires that create the demand for illegal street drugs, for cosmetic surgery, pop psychology, and some sex will be taken care of by biotechnology. If you want to feel better, act better, or look better, it will be arranged through biotechnology.

Again though, this technology will cause such obvious discrepancies between the so-called advantaged and others, and will create such let-downs for those who use the technologies, that the less rationalistic but meaningful issues of human existence will become paramount. Today we extract brain tissue from dead babies and inject it into the brains of old folks to treat their diseases. Just what does it mean to be human tomorrow?

Schools, Technology, and Catastrophe

To the degree that anything like organized schooling remains in the aftermath of the events just described, schools are not easily imagined. However, the events will tend to lead to the following conditions around schooling and educational technologists. Several events could each lead to the same kinds of conditions so the first several conditions, unlike later ones, are not attached to a specific event from above.

- Most Western/American schools will largely fail in the face of the transportation, natural resources, information, population, and biotechnical upheavals described here. Huge numbers of students won't be able to get to school. Conventional school years will be lost. Students will fall behind usual measures of learning progress. School "districts" will be very small, locally

run, and in neighborhood buildings (not school buildings as we know them). School systems won't have the money, students, transportation, or even the desire for consolidation, for busing of a few learners, or for distance education. Ironic? The new days sound like the old days of one room schools.

- Many of today's educational issues (What is a broadly educated person? How do we train good teachers? How do we get teachers to use computers?) will seem unimportant or even pompous because the few schools that exist will have curricula that mostly address day-to-day survival. Schools, in a sense, will be more vocational than they are today. If circumstances are somehow less bodily threatening, school curricula will address both survival issues and philosophical/ethical issues about sharing with other cultures. Of course, the ugly souls among us will discuss defending our culture against "outsiders." And some learners who are from more oppressed American backgrounds (e.g., some Appalachians) will come to see clearly that the gaps between them and the well-fed of the U.S. are unnecessarily large, as was the case in the "growth" decade of the 1980s (Harrington, 1984). A number of these oppressed students will rebel violently and attack power centers such as principals' offices and school boards. (I wonder: Is this last point a speculation about tomorrow or a reiteration of today's reality?)

- There won't be much electronic educational technology except where the powerful have very locally generated electricity and the capacity to use machines that existed as the catastrophes hit. Only very few schools will use electronic data, communications, or

teaching systems. Most districts won't use much electronic technology at all, let alone "cutting edge" electronic technologies; schools couldn't afford the electricity, and the hardware won't exist. Educational technology specialists who don't have more general educational and/or subsistence skills will disappear from what remains of the educational scene.

- Now about information upheaval. Even today, a frustrating amount of educational information is made and used by just a few people to maintain their political and economic power (If I may extrapolate somewhat from Spring, 1989; and see Anyon, 1988) as much as it's used to maintain any more "pure" educational purposes such as encouraging ecologically responsible learners who see their inherent dependence on people and the planet (Bowers, 1988). Further, today's educational systems are so bloated with information that they are often unmanageable and/or the information lies unused. Because they are large *systems*, and are largely rational-technical in nature, school systems have unexpectedly fostered conditions of learner disability. These systems encourage rational-technical knowledge at the expense of knowledge about tradition, language, and community (Bowers, 1987; Nichols, 1991). To some degree, then, large school systems have abetted conditions whereby they are culpable for 40 per cent of high school dropouts. The systems result in almost no parents directly participating in their children's educational process. School systems in much of the West are part and parcel of the devastating technological society that Ellul (1964) has been warning us about

for decades.

If we think that providing future communication technologies and more information is going to be a great boon to education, we are only slightly right at best. Mostly, there will be unhappiness that information isn't pertinent, is a closely guarded commodity, and is used to elitist purposes. Those without information power will rebel against their increased oppression, their apparently needless starvation and death. Even those of us in today's information middle-class (teachers?) will be disillusioned and angry when the false promise of the info-age is revealed and we are not better off in some basically meaningful ways. Perhaps there'll be info-wars.

- Finally we have biotechnology in education, where it will be called "educational biotechnology." Educational biotechnology (EBT) is the study and application of organized knowledge, processes, and products to physical (and therefore psychological) changes in humans in order to create controlled changes in learning (Nichols, 1991; and see Hanson and Gueulette, 1988). In short, we alter the body with chemicals, knives, engineering, and other tools in order to get people to learn predictably. Genes are engineered so you learn what you're supposed to learn.

  I predict that EBT will mushroom in this decade because traditional educational psychology has failed us. It has failed from a conventional social point of view that has recently concluded that we have a too large illiterate student workforce that is causing our country to become second-rate and from the more radical view that says typical psychology is one of the least

important elements in encouraging the development of thoughtful, personal and globally responsible, as well as skilled learners. In the first instance, a century of psychology has led to just about no educational successes, if we believe the reports of the last several years, reports that call our education a failure. In the more radical view, psychology fails because it is too reductionist; it's too removed from familial, social, political, economic, and philosophic exigencies that play the most important roles in learning.

EBT will explode into educational uses also because we are human and we love our inventions. We are inventors and risk-takers. This is so much the case that no matter the chance that lots of people will suffer from the unforseen effects of the use of some technology or another, we'll take that chance just to take chances and just to gain power over some thing or some one. You can't name one harmful technology that has been thought of that hasn't been developed once financial and materials problems were solved.

Schools will be overtaken by the rush of biotechnology that "really" gets results. Even now, chemicals immediately create a 10 per cent increase in memory retention (Gustafson, 1988). The rush will create turmoil for conventional learning measures, teaching techniques, school politics, and parental responsibility for children. Teachers and parents are not needed when learning strategies are pre-determined, optimal, and built-in via EBT.

Another, unexpected way schools will be overwhelmed is by a black market for EBT. When parents of a more traditional educational bent enact rules and laws to

try to stop EBT, a major result will be the growth of the black market and prices for EBT.

EBT means those of us who base our study of educational technology in conventional educational sciences such as psychology will be out of a job unless we go back to medical school or get degrees in biology.

The growth of EBT will exacerbate the conflicts we now have with racism, poverty, religion, and so on. For example, financially able whites who aren't especially bound by religious tenets that say "Let God work on the mind and body," will jump at the chance to use surgery and pills that give our kids advantages over others.

So EBT will cause profound doubt, dilemma, and moral consternation about modern thinking and technology. What does it mean to learn, to have knowledge, and to be human? It's ironic that the more we use rationality and technology, the more we are faced with their inability to answer life's basic questions.

What Can Be Done?

I have argued that the human compulsion to control existence gets us into trouble. That's why you ought to be skeptical about a "What To Do" section. But, being human, I'll outline some possible alternatives to catastrophe.

- First, we could keep to our current course, trying frantically to rationalize our way through the difficulties named herein. To me, this is an unconscionable approach. However, if the existence- threatening catastrophes happen, maybe we'll be forced to avoid annihi-

lation by making a quantum human leap into a better understanding of our existence and our philosophy.

- Current social developments such as the "green movement" or awareness of women's rights might somehow develop into saving graces. These developments are emerging partly in reaction to loss of human, meaningful, communicative competence (See Habermas, 1984, 1987; Damarin, 1990), and so are good counterpoints to the rational-technical philosophy. To this extent they are hopeful signs of human capability to overcome the catastrophes.

- Sternberg (1990) has a view of learning that could help us to avoid the reductionist character of rational-technical thinking. He suggests that we've conceived of human intellect in too narrow terms. I suggest that if we expand our basic notions of human intellect and learning to reflect thinking like Sternberg's, perhaps we can expand our notions of what constitutes a good modern philosophy that goes beyond predominant a rational-technical belief.

- Perhaps theoretic physics will become a predominant model of human learning and teaching. This physics is less instrumental than the rational-technical notions I've been addressing and in some ways is more explanatory. It could be a unifying theory for psychology, philosophy, and grounded-practice. For example, in *The Emperor's New Mind: Concerning Computers, Minds and the Laws of Physics*, Penrose (1989) suspects that quantum gravity (not psychology) is responsible ultimately for human creativity and consciousness (and intelligence, then?) and that current

notions of artificial intelligence are beyond improbable. (See Fosnot, 1988, for a good exposition specifically related to educational technology and physics.)

- Active educational resistance to the "advancement" of rational- technical existence is an option. Taylor and Johnsen (1986) have argued this approach very well. We should teach not just technical literacy (such as how to use a computer), but we should teach the fundamental histories and characters of technology itself so that we might be able to sensibly reign unchecked science and technology.

- The dangers associated with the rational-technical philosophy must lead us to consider fully its moral and ethical implications. In fact, we will be unable to avoid thinking mainly in these terms when our rationalism has brought enough disillusionment and despair, when food and shelter are no longer easily accessible to us, when our loved ones die and we believe their deaths are needless. And in this thinking of ethics, morality, and technology, you must consider two issues: your dependence on a community of people in a physically finite and delicate world (Bowers, 1988), and the ultimate purposes to which educational technology is put (Nichols, 1988).

Post Script

There is one more event to mention, which could make the others more or less moot.

- Nuclear weapons will be used. Use of nuclear weapons will halt glowing predictions of a technological future– except for predictions of a radiation glow. Ironically,

people of so-called developing countries are likely to be the first to use this weaponry again, perhaps because they are somehow insane or because they have such deeply held beliefs about protecting their local traditions or because they are oppressed or because they somehow haven't lived the experience of the first nuclear weapons use. Regardless, a regional war will affect all other regions of the world. There will be widespread death and long-term injuries. Into the twenty-first century, nuclear winter will chill the earth. Survivors will teach youngsters. . .

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VIEWPOINT

Rhonda S. Robinson
Northern Illinois University

Analysis and critique of education from an historical or philosophical perspective has a long and honored tradition. As new areas of philosophy or new methods of review emerge, those analyzing education have adopted new methods to continue their inquiry. However, some fields within education have a comparatively short history. Such new fields may begin with one focus for inquiry, and pursue research questions to establish the field. The limitations imposed by a narrow focus have an advantage, too, in that the research can proceed to establish a "known" body of research in a developing field. Such is the case in educational technology.

Emerging as a separate field in the 1940's, Educational Technology drew upon theory bases from psychology, learning, and perception. The field was derived primarily from behavioral and psychology, and consequently based its seminal research on experimental models appropriate to the time, and to early questions and hypotheses developed. Media was tested experimentally, and found (at the time) to be effective.

In the over forty years of research that followed, the same experimental paradigm predominated. New media were tested against old, characteristics of learners and specific media were compared, and relationships between learners and media were explored, all using various accepted experimental designs.

More recently, the field has broadened its definition to include instructional design, media analysis, and learner attitudes among other topics. Researchers are asking a variety of new questions, many of which would be difficult to examine using traditional experimental methods.

Currently, most of the published scholarship in educational technology has been based upon experimental and descriptive studies. The leading researchers, those who train future scholars in research methods, have accepted these studies as our models. Many researchers have only recently begun to accept a full range of research methodologies for educational technology. Consequently, educational technology journals publish few studies asking non-experimental questions, those based upon non-experimental designs. Since reports of alternate methodologies are few, researchers in educational technology have only the models of research reports in other fields to assist them in research design and reporting.

The Paradigm Quandary

Recently, much debate in educational technology has emerged around the "paradigm shift" that many scholars are noting if not applauding. There seem to be three basic approaches to this debate. First, the "died in the wool" empirical researchers, whose training and practice have encouraged them to see only questions for research that need quantitative methods for inquiry. These researchers have been heard to discuss the "paradigms" of educational technology when what they were discussing was the variety of technologies and design techniques needing further quantification and investigation. These researchers have not really yet acknowledged that meaning can be derived non-experimentally.

Second, there are the researchers and scholars who report that they appreciate both perspectives: the empirical and the more "naturalistic." Often, however, these researchers have confused methods of inquiry with actual paradigms of knowing. They will report that they have accepted qualitative methods, but the questions they research are empirically based, and those methods are merely one more data gathering technique in an empirical study.

Many, however, question the prevailing paradigm under which our research is conducted. There is a large difference between recommending surveys or interviews or even observation and recommending that the field consider a paradigm other than the scientific paradigm now guiding our research. Several presentations at our A.E.C.T. conferences have made clear the need for the field to grow in new directions; a growth made possible only by the posing of essential questions in new frameworks. A new science model has been recommended, as has an artistic model (Eisner) or a semeiotic model (Barthes), among others. This question of paradigm shift must be discussed and resolved as we move into the 1990's and our research moves into new areas.

Third, are the researchers whose ideas are represented in this journal. Many have explored, discovered and integrated new paradigms for knowing in to their own approaches to educational technology. They have acknowledged that "knowing" can take on many meanings, and that our field has been limited by its past sense of the "known." The non-scientific paradigm can be productively used to develop new areas and methods of research in instructional technology. Methods such as linguistic analysis, phenomenology, case study, grounded theory, action, participation, observation, and simulation can all be "bor-

rowed" from other, well-defined and developed disciplines and applied to our field. These methods are not considered "soft" in other fields, and have as their advantage the development of breadth and depth of research not possible in the experimental methods.

This awkward paradigm debate has misserved the progress of our field. Instead of arguing which side we face, or belittling the contributions of the other side, we should be debating how to best improve and enhance the progress of our field. With such acceptance of a duality of perspectives would come great growth and some much needed refocusing of directions.

Our field has been criticizing itself long enough. For ten years we have had valued scholars gently (or not so gently) indicating that we need new questions, new fields of inquiry, and new horizons for innovation. We have read and discussed these recommendations —but where is the debate leading us? The educational world still has a fairly limited and skewed idea of what kind of contributions we can make to the improvement of education. We have yet to be embraced or even approached as part of the solution to the crisis in education or the answer to the challenge of the next century.

The paradigm debate should be declared a draw. If we would just accept that there are many ways of knowing and many questions left unanswered, we could proceed. Those scholars interested in perfecting experimental techniques to investigate the effectiveness of specific design, production, or utilization of technologies could proceed to do so. But only with the understanding that they are asking only part of the question; that they are focusing on external reports and not the whole learner.

Conversely, those involved in "alternate" paradigms

could drop that term from their vocabularies. All ways of knowing and all social constructs would be equally accepted and represented in our literature. Not just methodologies but approaches to understanding would be accepted and incorporated into the teaching and practice of research in our field. Individuals would be encouraged to question and consider how they approach the world, how they understand learning, and how they believe knowledge is achieved. If these kinds of questions were encouraged from the outset, then we could all have more confidence in the results of research reported by those in any "camp." When we have all examined the philosophical and social concerns and perspectives represented here, we will more easily accept the results of ensuing research.

It is time for our field to move ahead, to accept the dual perspectives of our paradigm debate. Enough time has passed, enough words have been shared, enough borrowing from other areas has been discussed, for all of us to accept that this is a non-debate. We need to move ahead with our research in all areas, to pursue questions from all perspectives, if we are to meet the challenges of the future and be at all helpful in shaping the educational success of the next century.

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